MAY, 1934.

GENERAL PHYSICS.

ADSORPTION.

1760. Adsorption of Carbon Dioxide and Hydrogen on Bare and Oxygen-Covered Silver Surfaces. L. C. Drake and A. F. Benton. *Am. Chem. Soc., J.* 56. *pp.* 506–511, *March*, 1934.—On Ag, CO_2 is adsorbed physically with a heat of 5000 cal., the amount adsorbed being almost the same as that of O. Physical adsorption of H_2 is very small even at −193° C., but above 200° C. activated adsorption occurs. This H_2 is readily pumped off again at 300° C. Oxidised surfaces react with CO_2 to form carbonate, as low as 56° C., with heat of formation of 17,300 cal. and 13,000 cal. energy of activation. A. S. C. L.

1761. Heat of Adsorption of Carbon Monoxide on Copper. R. A. Beebe and E. L. Wildner. *Am. Chem. Soc., J.* 56. *pp.* 642–645, *March*, 1934.—Using a calorimeter designed to eliminate as far as possible all known sources of error, measurements were made of the differential heats of adsorption for CO on Cu at 0°. Over a working period of four months the Cu retained an almost constant degree of activity. It was found that in the initial stages, the differential heats decreased markedly as successive small portions of the gas were added to the surface. N. M. B.

1762. Form of Isothermals of Vapour on Charcoal and its Relation to Hysteresis. L. J. Burrage. *Faraday Soc., Trans.* 30. *pp.* 317–325, *March*, 1934.—A reversible hysteresis loop has been observed in the adsorption isothermals of CH_3OH, C_2H_5OH, C_3H_7OH, $H\cdot COOH$, and CCl_4 on charcoal. The meaning of these results is discussed. A. S. C. L.

1763. Adsorption of Electrolytes by Crystalline Surfaces. (Miss) L. de Brouckere. *Comptes Rendus*, 198. *pp.* 822–824, *Feb.* 26, 1934.—The adsorption of KI, KCl and NaCl on negatively charged $BaSO_4$ is similar to that upon the positively charged substance. This is in accord with the idea of ionic attachment to the crystal lattice of the adsorbent, the positive ion of the adsorbed salt being attached to the negatively charged surface, while the negative ion is attached directly to the positive surface. A. S. C. L.

1764. Sorption of Water by Cellulose. S. E. Sheppard and P. T. Newsome. *Indust. and Engin. Chem.* 26. *pp.* 285–290, *March*, 1934.—Sorption of water by cellulose depends upon its previous history. The highest values are given by specimens regenerated after solution in cuprammonium, xanthogenation or esterification. No connection is found between sorption and size of macro-molecule so it is assumed that the arrangement of atoms in the chains is the determining factor; particularly the accessibility of OH groups. Total sorption is the sum of specific chemical sorption and capillary condensation. A. S. C. L.

1765. Gaseous Adsorption. E. Habann. *Ann. d. Physik*, 19. 5. *pp.* 501–512, *March*, 1934.—The author studies the absorption of gases in vanadic anhydride powder, by observing the current and p.d. of a capsule over a period of time and with various pressures. Assuming that the gas has an electronic affinity, the adsorbed gas appears as a space charge and exhibits itself in the p.d. With large currents, the space charge vanishes, and the p.d. drops rapidly, giving a measure of the adsorbed gas. Neutralised gas diffuses outwards from the contact region, but a fraction is retained by the adsorbed forces. It is, however, removed by weak currents with rise in p.d. The technique enables the adsorption forces and the consequent catalytic properties of solid bodies to be investigated. L. E. C. H.

See also Abstract 2041.

ATOMIC AND MOLECULAR STRUCTURE.

1766. Interaction of Two Helions. W. M. Elsasser. *J. de Physique et le Radium*, 5. *pp.* 71–74, *Feb.*, 1934.—In a mainly mathematical paper the author investigates an approximate method for calculating the interaction between two helions. The wave-function can be regarded as a function representing the movement of their centre of gravity multiplied by a series of functions representing the internal state of the helions. The latter series is not, in general, orthogonal, and this fact causes complications. The method can only be applied provided the distances between the helions is large compared with their dimensions. It is deduced that the representation of a nucleus as composed of helions is liable to lead to error. J. E. R. C.

1767. Artificial Transmutation of Magnesium by Polonium α-Rays. H. Klarmann. *Zeits. f. Physik*, 87. 7–8. *pp.* 411–424, *Jan.* 26, 1934.—Using a Rutherford-Geiger proportional counter, of which details of special tests are given in the paper, the author has obtained absorption curves of the protons emitted by Mg (1 mm. thick) under the action of Po α-rays of range 1·81 to 3·93 cm. in air. The direction of the protons observed was perpendicular to that of the α-rays. The curves indicate the existence of 4 proton groups. The ranges of the groups and those of the corresponding exciting α-particles are given. Some of the groups are resonance groups, since the energy of the respective exciting α-particles lies between narrow limits. W. E. P.

1768. Photographic Investigation of Artificial Disintegration. (Miss) M. Blau. *J. de Physique et le Radium*, 5. *pp.* 61–66, *Feb.*, 1934.—A technique which has been developed for measuring the range of protons by allowing them to fall obliquely upon a photographic emulsion is described. The products of the artificial disintegration of Al are investigated and groups of protons are found corresponding to those reported by Chadwick and Constable [see Abstract 2889 (1932)]. Protons expelled from paraffin wax by neutrons radiated from beryllium are also investigated J. E. R. C.

1769. New Isotope of Argon. P. Zeeman and J. de Gier. *K. Akad. Amsterdam, Proc.* 37. 3. *pp.* 127–129, 1934.—Using an improved form of Thomson's mass-spectrograph, a new faint parabola 38, in addition to the strong 40 and faint 36, was found [see Abstract 5102 (1933)], and indicates the inert gas ion for the argon isotope A^{38} ++. N. M. B.

1770. Isotopic Composition of Sea Water. E. S. Gilfillan, Jr. *Am. Chem. Soc., J.* 56. *pp.* 406–408, *Feb.*, 1934.—Pure water obtained from the sea has a specific gravity of 1·0000023 at 0° C. compared with tap water purified in the same way. A. S. C. L.

1771. Examination of Natural Water for Variations in Isotopic Composition. E. W. Washburn and E. R. Smith. *Bureau of Standards, J. of Research*, 12. *pp.* 305–311, *March*, 1934.—The densities of samples of water from various natural sources have been measured in an effort to detect differences in isotopic composition. Small differences have been found in the following cases: After the removal of all non-aqueous constituents, the water of the ocean, of the Dead Sea, and of Great Salt Lake is denser than pure normal water by about 2, and the water of crystallisation of native borax tetrahydrate, kernite (" rasorite "), by about 7 parts per million. The sap water from a young willow tree was heavier than normal water by 2·8 and the water produced by burning the dry wood was heavier by 5·4 parts per million. A differential pycnometer method for measuring differences in density with a precision of 1 part in 1,000,000 is described. AUTHORS.

1772. Theory of the Electrolytic Separation of Isotopes. R. P. Bell. *J. Chem. Phys.* 2. *pp.* 164–166, *April*, 1934.—(1) Gurney's treatment of overvoltage has been applied to the relative rates of discharge of two isotopes. As a first approximation it is found that the separation efficiency should be nearly independent of the electrode material and the current density. This agrees with the data at present available for the separation of the isotopes of hydrogen. (2) A more rigid treatment predicts small variations of the efficiency with the nature of the electrode and the current density, but is not at present able to predict these variations quantitatively. (3) The application of the theory to other isotopes is indicated, and a rough estimate given of the possibility of separating Li^6 and Li^7 by electrolysis. AUTHOR.

1773. Theory of Separation of Hydrogen Isotopes by Electrolysis. R. H. Fowler. *Roy. Soc., Proc.* 144. *pp.* 452–466, *March* 29, 1934.—The process of electrolysis is a steady one and the requirements of a steady state are here systematically applied to the possible mechanisms of the hydrogen electrode which have been suggested. The self-diffusion of water is important and suffices to keep the H/D ratio near the kathode normal in spite of the different mobilities of the H and D ions. If there were no to-and-fro exchange of hydrogen between solution and kathode, then the separation would depend on differential rates of transition for protons and diplons, according to the suggestions of Polanyi; this exchange certainly exists so that Polanyi's explanation, though still possible, is no longer unique. It is shown that the separation may be due either to different overpotentials, as suggested by Polanyi, or to different combination rates of molecule-formation on the surface or partly to both causes. The general space-charge equations governing a steady electrolytic current in the alkaline electrolysis of water are formulated. J. S. G. T.

1774. Heavy Hydrogen. R. H. Fowler. *Cambridge Phil. Soc., Proc.* 30. *pp.* 225–241, *April* 30, 1934.—The steps are recounted by which the heavy isotope was isolated, *viz.*, the conclusion that ordinary hydrogen contains a heavy constituent in the proportion of 1 part in 5000; the displacement of the hydrogen lines by a fractional distillate from liquid hydrogen; the determination of the relative mass of this new body as approximately 2; and the separation of it by water electrolysis. A table is given of the more important properties of water, H_2O, and of heavy water, D_2O, *e.g.*, densities at 20° C., 0·9982, 1·1056; freezing points, 0°, 3·8°; boiling points, 100°, 101·42°; temperatures of maximum density, 4°, 11·6°. The tabulated values are used to check and revise current theories on the structure of water. A second application deals with the mechanism of the hydrogen electrode. A comparison of the rates of transition of H and D will reveal whether the proton transition is or is not the important factor which governs the rate. In this respect D_2 may prove to be of biological importance. G. E. A.

1775. Heavy Hydrogen. A. and L. Farkas and P. Harteck. *Roy. Soc., Proc.* 144. *pp.* 467–493, *March* 29, 1934.—Thermal conductivity of H_2-D_2 mixtures is measured at low pressures by the heat loss from a wire. The variation of thermal conductivity with temperature is used as a micro-method for estimation of the D_2 content. HD molecules behave for this purpose as D_2 molecules, so that formation of the equilibrium mixture containing HD from H_2 and D_2, by dissociation into atoms and re-association into H_2, D_2, and HD, results in an increase of resistance of the hot wire. Equilibrium occurs in a few seconds at a Ni surface of 600°. No HD could be detected after absorption of H_2 and D_2 on charcoal at 77·3° K. H and D atoms diffuse at similar rates through Pd above 300° C.; but as temperature falls D is retarded. The difference cannot be used as a method of separation of H and D owing to the smallness of the actual rates at the lower temperatures necessary for fractionation. The ortho-para conversion of D_2 has been followed by the authors' micro-method. As with H_2, the conversion is catalysed by charcoal and at 20·4° K. the rate is similar for H_2 and D_2. Reconversion, by O_2, is 16 times smaller for D_2. A. S. C. L.

1776. New Hydrogen. (Lord) Rutherford. *Nature,* 133. *pp.* 481–484, *March* 31, 1934. *Discourse delivered at the Royal Inst., March,* 1934.—An account is given of the observations which led to the discovery of the existence of H^2, of its properties and nuclear structure, and of its use in the disintegration of light elements; also of the preparation and properties of "heavy" water, and of the preliminary experiments made on its effect on the processes of animal and vegetable life. T. H. P.

1777. Structure of Liquid Benzene, Cyclohexane and Their Mixtures. H. K. Ward. *J. Chem. Phys.* 2. *pp.* 153–159, *April,* 1934.—Carefully purified benzene and cyclohexane exhibit X-ray diffraction peaks corresponding to preferred spacings of 4·68 Å and 5·09 Å, respectively, which are interpreted as the effective thicknesses of the respective rings. Mixtures of these two hydrocarbons give rise to two independent diffraction peaks indicating emulsion-type solutions, in which the disperse phase is too small to show even a Tyndall effect. AUTHOR.

1778. Allotropy of Liquid Benzene. E. Cohen and J. S. Buy. *K. Akad. Amsterdam, Proc.* 37. 2. *pp.* 55–61, 1934.—It is shown that the conclusions of Menzies and Lacoss [see Abstract 2288 (1932)] according to which the temperature curves of the density, refractive index and specific heat of benzene between 0° and 70° C. show a point of abrupt change is in opposition to observations. Young and Breen's and Meyer and Mylius's observations of specific volume do not support Menzies and Lacoss's views. For refractive index Parker and Thompson's values show a continuous curve, while for specific heat between 0° and 58° C. Tréhin's observations show a continuous curve and no abrupt change at 44° C. Also if an abrupt change did occur in the curve the author considers it erroneous to suppose that the liquid benzene was allotropic. R. S. R.

1779. Hydrols. W. D. Bancroft and L. P. Gould. *J. Phys. Chem.* 38. *pp.* 197–211, *Feb.,* 1934.—The Hofmeister series is explained as due to changes in the association of water and to selective adsorption of ions. Differences in the series under different conditions are due to one or other factor being dominant. Other physical properties of aqueous solutions are explained as due to variation of polymerisation of the solvent water. A. S. C. L.

1780. Apparent Molecular Association of Aliphatic Acids. G. Broughton. *Faraday Soc., Trans.* 30. *pp.* 367–372, *March*, 1934.—Freezing point depressions have been measured for solutions of the saturated monobasic acids in cyclo-hexanol. Association decreases up to lauric acid and then increases again. The solubility of the higher members is rather small. A. S. C. L.

1781. Limiting Gas Density Method for Molecular Weights. R. T. Birge and F. A. Jenkins. *J. Chem. Phys.* 2. *pp.* 167–183, *April*, 1934.—In this, the first of a series of papers, a general discussion is given of the limiting gas density method for the determination of molecular weight. The various methods that have been used, or might well be used for the reduction of the data, are compared in a systematic way, and the most desirable methods for such work are pointed out. These methods are then applied to selected data given in the literature, and are compared with the actual published calculations and results. The paper closes with certain conclusions drawn from the preceding analysis. AUTHORS.

See also Abstracts 1799, 1811, 1876, 1889, 2048, 2056, 2057, 2078, 2085, 2106, 2138, 2180, 2181, 2182.

COLLOIDS.

1782. Nature of Radio-Colloids. M. Haïssinsky. *Comptes Rendus*, 198. *pp.* 580–583, *Feb.* 5, 1934.—The colloidal properties of bismuth compounds are similar to those of the radio-elements. A. S. C. L.

1783. Electrochemistry of Colloids. W. Pauli and E. Valkó. *Kolloid Zeits.* 66. *pp.* 312–316, *March*, 1934.—Certain of the points recently raised by Mukherjee [see Abstract 4727 (1933)] in connection with the electrical properties of colloids, particularly those concerned with the determination of the electrical mobility of colloids, are discussed. The history of the development of the electrochemistry of the colloids is outlined and, as regards Hittorf's transference experiment, it is pointed out that the phenomena at the surface play no part therein, provided that the middle layer remains unaltered. The marked deviation of the activity and conductivity coefficients of colloids is explainable by the extreme position occupied by colloids in the electrolyte region. Such position is based on the extreme values shown by the valency and magnitude of the colloid ion and the counter-ion (*Gegenion*). Most of the available accurate determinations on sufficiently charged pure sols show that, as with strong electrolytes of higher valencies, the activity coefficient of the counter-ion is greater than its conductivity coefficient. The contrary results which have been occasionally found are due mostly to the presence of impurities, complex ions, or highly mobile micelle ions. T. H. P.

1784. Mechanical Properties of Disperse Systems. Part III. Action of Vibrations on the Deformation of Disperse Pulverulent Substances. G. I. Pokrowski and I. S. Fedoroff. *Kolloid Zeits.* 66. *pp.* 270–272, *March*, 1934.—A statistical method is employed to arrive at a representation of the deformation velocity of coarsely-disperse bodies as a function of the frequency and force of the vibrations to which they are subjected. The formulæ deduced should be applicable to deformations of the most varied types, and are found to be in agreement with the results of experiments with water-saturated sand. [For Part II see Abstract 1403 (1934).] T. H. P.

1785. Viscosity of Asphalt Bitumen and Tar. W. Rödiger. *Kolloid Zeits.* 66. *pp.* 351–357, *March*, 1934.—Graphs and tables are given for measurements of viscosity, at various temperatures in a Tsuda-capillary viscometer, of tar, bitumen and their mixtures. It is shown that for soft Mexican bitumen the measurements obtained agree with the Hagen-Poiseuille law, whereas distilled coal tar agrees only at higher temperatures. It is also pointed out that tar-bitumen mixtures at 57°C. show structure-viscosity, particularly for mixtures of equal quantities. J. K.

1786. Change of Viscosity of Asphalt with Temperature. H. Umstätter. *Kolloid-Beihefte*, 39. 5–7. *pp*. 264–276, 1934.—The author shows by means of numerical examples with what degree of validity the viscosity formula based on his damping theory can be applied to slightly damped systems. The same table of figures is used to obtain an approximate formula for strongly damped systems. This formula is found to be in agreement with the figures obtained for a further viscosity range. It is shown that the heats of cohesion for the investigated asphalts can be calculated by means of this approximate formula and that these heats of cohesion are characteristic constants of the material. J. K.

1787. Preparation of Microscopic Glass Spheres. S. Sklarew. *Indust. and. Engin. Chem.* (*Analytical Edition*), 6. *pp*. 152–153, *March* 15, 1934.—Particles of powdered glass, blown into a white hot chamber, melt into perfect microscopic spheres whose diameters vary from 10^{-2} to 10^{-5} in. Full details of a successful method, based on this principle, are given. J. P. A.

1788. Viscosity of Froth. J. O. Sibree. *Faraday Soc., Trans.* 30, *pp*. 325–331, *March*, 1934.—A froth system has anomalous viscosity at low rates of shear. At higher rates, the viscosity agrees with that calculated by Hatschek's formula, provided that the specific volume of the disperse phase is multiplied by a factor of about 1·3. A. S. C. L.

1789. Magnetic Study of Sols and Gels. S. Prakash. *Indian Journ. Phys.* 8. *pp*. 243–258, *Dec*. 15, 1933.—In dilute solutions of ferric and chromic chlorides, hydrolysis to colloidal hydroxides lowers the magnetic susceptibility. Addition of sodium acetate to solutions of these salts also lowers it as a result of the formation of basic salts. Changes occurring in other colloidal systems are also described. A. S. C. L.

1790. Colloidal Air. Part II. A. Krause and K. Kapitanczyk. *Kolloid Zeits.* 66. *pp*. 288–292, *March*, 1934.—The present paper refers to the determination of the particle size of colloidal air and is a continuation of the work described in an earlier paper [see Abstract 1006 (1932)]. It is now shown that the alkaline air sols give on dilution the Tyndall phenomenon quite sharply without the necessity of adding glycerin. The size of the air bubbles is about 0·14 μ. J. K.

See also Abstracts 1777, 1841, 1934, 1971, 2163.

CRYSTAL STRUCTURE AND PROPERTIES.

1791. Wave Propagation in Crystal Lattices. K. Försterling. *Ann. d. Physik*, 19. 3. *pp*. 261–289, *Feb.*, 1934.—The study of the motion of electron waves in crystal lattices has shown that the eigenenergies of the electrons are not distributed uniformly over the energy scale, but exhibit lacunæ in the neighbourhood of the wave-lengths satisfying Bragg's condition. The author is concerned with the optical analogue of this effect. In the one-dimensional case, optical experiments on lamellar media such as Lippmann's colour plates, show anomalous dispersion at wave-lengths satisfying the Bragg condition. This anomalous dispersion is closely connected with the gaps in the energy spectrum. The mathematical theory of the three-dimensional case of wave propagation in a medium exhibiting periodic changes in its properties in all three directions, is developed. The theory applies equally to propagation of electromagnetic waves in accordance with Maxwell's equations and propagation of electron waves in accordance with Schrödinger's equation. The relation between anomalous dispersion in Lippmann plates and the gaps in the energy spectrum of electron waves in crystals, is elucidated by the theory. W. S. S.

1792. Lattice Energies of Ammonium Halides and the Proton Affinity of Ammonia. W. E. Bleick. *J. Chem. Phys.* 2. *pp.* 160–163, *April*, 1934.—The lattice energies of NH_4F and of the CsCl-type lattices of the other ammonium halides are computed by the method of Born and Mayer, assuming ionic crystals with a van der Waals potential. The calculations appear to be quantitatively satisfactory for the chloride, bromide and iodide. The method fails, however, for the asymmetrical fluoride lattice, and another method is employed. The theoretically calculated lattice energies in k.cal. are, NH_4Cl, 161·6; NH_4Br, 154·9; NH_4I, 145·5. From these lattice energies by means of a thermal cycle the energy change at 0°K of the reaction $NH_{3\,gas}+H^+_{gas}\rightarrow NH_4{}^+_{gas}$, which may be called the proton affinity of ammonia, is found to be −206·4 k.cal. With this proton affinity and the same cyclic process the lattice energy of NH_4F is calculated to be 191·4 k.cal. AUTHOR.

1793. Parameter Values of Cu-Ni Alloys. E. A. Owen and L. Pickup. *Zeits. f. Krist.* 88. *pp.* 116–121, *May*, 1934. *In English.*—Measurements made with a precision X-ray camera show that lattice contraction occurs when pure Cu and Ni are alloyed. The maximum contraction (0·11 %) occurs at about 34 atomic % Ni. The parameter value of this alloy is $3\cdot573_4$ Å. The corresponding density is $8\cdot94_9$ gm. per cc. The measurements are made at 18° C. J. T.

1794. X-Ray Examination of Silicon Alloys. B. Borén. *Arkiv f. Kem. Min. och Geologi, Stockholm*, 11 *A*. 10. [28 *pp*.] 1934. *In German.*—The alloys of Si with Cr, Mn, Co and Ni are examined by X-rays. They are prepared in a h.f. furnace and examined in the form of powders, focussing cameras being employed. Four intermediate phases are found in the Cr-Si system. The first, corresponding to Cr_3Si is cubic, with a = 4·555 Å. There are 8 atoms in the unit cell. The co-ordinates are given. The second phase is complicated, and is not described. The third corresponds to CrSi and is like FeSi. The length of the edge of the unit cube is 4·620 Å. The space group is T^4 and there are 8 atoms (parameters given) in the unit cell. The fourth phase, corresponding to $CrSi_2$ is hexagonal with a = 4·422 Å, c = 6·351 Å, and c/a = 1·44. The space group is $D_6{}^4$ and there are 9 atoms (co-ordinates given) in the unit cell. Three intermediate phases are found in the Mn-Si system. The first, corresponding to Mn_3Si is hexagonal with a = 6·898 Å, c = 4·802 Å, and c/a = 0·696. The unit cell contains 16 atoms. The second phase, corresponding to MnSi has the FeSi structure with a = 4·548 Å. The atomic parameters are given. The third phase corresponds to $MnSi_2$. It is tetragonal with a = 5·513 Å, c = 17·422 Å, and c/a = 3·16. The unit cell contains 48 atoms. The Co-Si system contains only two intermediate phases. The first, corresponding to Co_2Si is orthorhombic with a = 3·730 Å, b = 4·908 Å, and c = 7·095Å, $a:b:c:$ = 0·76 : 1 : 1·45. The space group is C^9_{2v} or V^{16}_h. There are 12 atoms in the unit cell. The other phase corresponds to CoSi

and possesses the FeSi structure with *a* = 4·438 Å. The atomic parameters are given. The Ni-Si system is not examined very thoroughly but a compound NiSi is found, analogous to FeSi, with *a* = 4·437 Å. Si dissolves both cubic and hexagonal Co with lattice contraction, but Cr and Mn are insoluble in Si. Si is soluble in Cr and Co, with lattice contraction.
J. T.

1795. Structure of Talc. G. Aminoff and B. Broomé. *Arkiv f. Kem. Min. och Geologi, Stockholm,* 11 *B.* 25. [5 *pp.*] 1934. *In German.*—Electron diffraction photographs of talc are obtained. The talc is in the form of thin sheets, thin enough to show interference colours and a beam of fast electrons is passed straight through the sheet. From the resulting photographs it appears as if talc were hexagonal with the *c*-axis parallel to the electron beam. The value of *a* is 5·25 Å. From optical work, however, it is clear that talc can only be pseudo-hexagonal (monoclinic or orthorhombic).
J. T.

1796. Structure of Barium Nickelocyanide. H. Brasseur, A. de Rassenfosse, and J. Piérard. *Comptes Rendus,* 198. *pp.* 1048–1050, *March* 12, 1934.—$BaNi(CN)_4$, $4H_2O$ is monoclinic, $a : b : c = 0{\cdot}8722 : 1 : 0{\cdot}4940$, β 104°50′, d^{20} 2·383. X-ray gives *a* 11·89, *b* 14·08, *c* 6·54, β 103°42′ for the unit cell, with 4 mols. therein. The structure is identical with that of $BaPt(CN)_4$, $4H_2O$. The ion $[Ni(CN)_4]$ is therefore plane with the Ni in the middle of a square formed by the 4CN.
C. A. S.

1797. Structure and Growth of Surface Layers on Metals When Oxidised in Air. A. Steinheil. *Ann. d. Physik,* 19. 5. *pp.* 465–483, *March,* 1934.—The composition, structure and rate of growth of oxide layers formed on Al and Zn in air at ordinary and higher temperatures are investigated. The electron diffraction rings obtained with Al_2O_3 layers formed at room-temperature indicated a face-centred lattice of constant 5·35 Å. From the dependence of the rate of growth on the experimental conditions it is concluded that this anhydrous ϵ-Al_2O_3 is of unknown composition. Oxide layers about $4{\cdot}5 \times 10^{-5}$ cm. thick are formed when the metal melts in air γ-Al_2O_3 being formed, the chemical composition of which is known. Heating therefore changes not only the thickness but also the structure of the oxide film. Occasionally surface lattice interference patterns are obtained and these are attributed to single hexagonal crystals of β-Al_2O_3 with their long *c*-axis. Mixed monoxide and dioxide films are formed when zinc melts in air; these gave diffraction rings of small diameter which could not be measured accurately. The rate of growth of the film on Al was determined from observations on the amount of light transmitted as oxidation proceeded. The rate of growth was initially abnormally large, but it subsequently approached that predicted by diffusion theory. At the end of a month the film was about 4×10^{-6} cm. thick. A repetition process, similar to that occurring in the growth of crystals, is found adequate to account for the growth of oxide layers.
F. C. C.

1798. Structure of Yellow Mercuric Iodide. W. S. Gorsky. *Phys. Zeits. d. Sowjetunion,* 5. 2. *pp.* 367–368, 1934. *In German.*—Yellow HgI_2 was obtained by crystallisation from acetone. It has the structure of $HgBr_2$, *i.e.*, rhombic, with *a* 4·676, *b* 7·32, *c* 13·76 Å, and 4 mols. in the unit cell, space group C_{2v}^{12}. Each Hg is surrounded by 6 I atoms, two distant 2·62, the others 3·46 Å, the first two being much more firmly attached to that Hg atom. This affects its thermal movement, and explains the unexpectedly small scattering power of the Hg as compared with that of the I. C. A. S.

1799. Structure of the β-Form of Solid Carbon Monoxide. L. Vegard. *Zeits. f. Physik,* 88. 3–4. *pp.* 235–241, *March* 19, 1934.—The crystal structure of the β-Form of CO, stable above 61·5°K, has been investigated by the X-ray method and found to be practically identical with that of β-N_2. In both cases the molecules execute rotation movements in the lattice. The arrangement corresponds only approximately with that of the closest hexagonal packing of spheres. The density of β-CO has also been determined by the X-ray method and found to be 0·929 at 65° K. H. H. Ho.

1800. Structure of Nickel Bromide and Nickel Iodide. J. A. A. Ketelaar. *Zeits. f. Krist.* 88. *pp.* 26–34, *May,* 1934.—The sublimed compounds $NiBr_2$ and NiI_2 have the $CdCl_2$ type lattice. Considered as hexagonal, the constants are :—

$NiBr_2$, $a = 3{\cdot}71 \pm 0{\cdot}01$ Å, $c = 18{\cdot}30 \pm 0{\cdot}04$ Å ; NiI_2, $a = 3{\cdot}89 \pm 0{\cdot}01$ Å, $c = 19{\cdot}63 \pm 0{\cdot}04$ Å.

Considered as rhombohedral $NiBr_2$, $a = 6{\cdot}46 \pm 0{\cdot}02$ Å, $\alpha = 16°40'$; NiI_2, $a = 6{\cdot}92 \pm 0{\cdot}02$ Å, $\alpha = 16°20'$.

The parameter $u = 0{\cdot}255 \pm 0{\cdot}003$ and $0{\cdot}250 \pm 0{\cdot}05$ respectively, and the densities are 5·25 and 6·36 respectively. $NiBr_2$ (not sublimed) also shows another structure, with $a = 2{\cdot}11 \pm 0{\cdot}005$ Å, $c = 6{\cdot}08 \pm 0{\cdot}01$ Å, $u = 0{\cdot}250 \pm 0{\cdot}005$, density = 5·45. F. I. G. R.

1801. Structure of Ammonium and Potassium Cupric Chloride Dihydrates. L. Chrobak. *Zeits. f. Krist.* 88. *pp.* 35–47, *May,* 1934.—*In English.*—Powder and single crystal measurements have been made for $(NH_4)_2CuCl_4,2H_2O$ and $K_2CuCl_4,2H_2O$, and therefrom Fourier analyses. In the case of the NH_4 salt equally good results are obtained with the structures proposed by either Hendricks and Dickinson, or by Chrobak [see Abstracts 32 (1928) and 1304 (1930)], but in that of the K salt a slight modification of the former is indicated, in which both Cl parameters are changed to 0·218 (or 0·282), a change which differs appreciably from the original only as regards the position of the H_2O molecules. C. A. S.

1802. Atomic Arrangement of Ammonium and Cæsium Persulphates : Structure of Persulphate Group. W. H. Zachariasen and R. C. L. Mooney. *Zeits. f. Krist.* 88. *pp.* 63–81, *May,* 1934. *In English. Paper read before the Am. Phys. Soc.*—$Cs_2S_2O_8$ and $(NH_4)_2S_2O_8$ are monoclinic, with 2 mols. in the unit cell, space group C_{2h}^5–$P2_1/n$, and respectively *a* 8·13, *b* 8·33, *c* 6·46 Å, β 95°19′, and *a* 7·83, *b* 8·04, *c* 6·13 Å., β 95°9′. The S_2O_8 group is made up of two tetrahedral SO_4 groups (S–O = 1·50 Å) linked by a covalent bond between two O (O–O = 1·46 Å, this bond being inclined at 122° to the O–S bond). Each Cs (or NH_4 group) is surrounded by 12 O atoms at average distance 3·18 Å. All parameters are determined, and agreement between structure and optical properties is demonstrated. C. A. S.

1803. Structure of Alkali Salts. C. D. West. *Zeits. f. Krist.* 88. *pp.* 97–115, May, 1934. *In English.*—The structures of the following substances are determined by the powder method : K_2S, CsSH, NH_4SH, NaSH, KSH, RbSH, LiSH, Li_2Se, and Li_2Te. K_2S, Li_2Se and Li_2Te have the CaF_2 structure with $a = 7{\cdot}35$ Å, 5·94 Å, and 6·47 Å respectively. CsSH has the cubic CsCl structure with $a = 4{\cdot}29$ Å. NH_4SH is tetragonal with $a = 6{\cdot}01$ Å, and $c = 4{\cdot}01$ Å. The atomic co-ordinates are given. NaSH, KSH and RbSH are isomorphous, being rhombohedral. The space group is D_{3d}^5 and the lattice constants are: NaSH, $a = 3 \cdot 99$ Å, $\alpha = 68°5'$; KSH, $a = 4 \cdot 37$ Å, $\alpha = 68°51'$; RbSH, $a = 4 \cdot 53$ Å, $\alpha = 69°20'$. They are also dimorphous, having an NaCl structure at high temperatures. The lattice constants are: NaSH, $a = 6 \cdot 05$ Å; KSH, $a = 6 \cdot 60$ Å; RbSH, $a = 6 \cdot 93$ Å. J. T.

1804. X-Ray Study of Two Red Monoclinic Varieties of Selenium. H. P. Klug. *Zeits. f. Krist.*, 88. *pp.* 128–135, *May*, 1934. *In English.*—In agreement with the work of Halla, Bosch and Mehl [see Abstract 2166 (1931)] the unit cell of the α form was found to contain 32 atoms of Se and to have the dimensions: $a'_0=8 \cdot 992$ Å; $b'_0=8 \cdot 973$ Å; $c'_0=11 \cdot 52$ Å; $\beta'=91°34'$. The space group of the α form is probably C^2_{2h}. The β variety has a cell with the following dimensions: $a_0=12 \cdot 74$ Å; $b_0=8 \cdot 04$ Å; $c_0=9 \cdot 25$ Å; $\beta=93°4'$. It is very probable that the cell contains 32 atoms, in which case the calculated density of the β form is $4 \cdot 42$. Its space group is probably C^5_{2h}. The possibility of a structure closely similar to that of rhombic S is pointed out, especially for the α form.
AUTHOR.

1805. Structure and Colour of $CoCl_2$. H. Grime and J. A. Santos. *Zeits. f. Krist.* 88. *pp.* 136–141, *May*, 1934. *In English.*—The structure of $CoCl_2$ at room-temperature is determined by the powder method. It is found to be rhombohedral with $a=6 \cdot 16$ Å and $\alpha=33°26'$. There is one molecule in the unit cell and the probable space groups are C_{3v}^5, D_3^7 and D_{3d}^5. The atomic coordinates are given. $CoCl_2$ is blue an should, according to previous work, have a structure with a four coordinated Co atom. The present structure gives a six coordinated Co atom. On cooling to liquid-air temperature the colour changes to pink but no corresponding change of structure is found. J. T.

1806. Lattice of Boric Acid. W. H. Zachariasen. *Zeits. f. Krist.* 88. *pp.* 150–161, *May*, 1934. *In English.*—H_3BO_3 is holohedral triclinic, a 7·04, b 7·04, c 6·56, α 92°30′, β 101°10′, γ 120°, with 4 mols. in the unit cell. The structure is a pile of two dimensional hexagonal lattices in which the O of the BO_3 groups are linked to each other through H atoms; B–O$=1 \cdot 36$, O–O (in O–H–O)$=2 \cdot 71$ Å. The layers are 3·18 Å apart, and held together by weak bonds, probably of van der Waals, and not ionic type, thus explaining the cleavage; successive layers are placed relatively to one another so that O atoms of one are almost directly above or below B or H atoms of the next; hence the triclinic nature of the crystals. C. A. S.

1807. Structure of Silver Nitrate-Urea Addition Compound. G. L. Clark and C. O. Werner. *Zeits. f. Krist.* 88. *pp.* 162–172, *May*, 1934. *In English.*—$[AgNO_3,CO(NH_2)_2]_n$, d 2·84, has a 10·23, b 16·84, c 6·25 with $8[AgNO_3,CO(NH_2)_2]$ in the unit cell; space group probably C^2_{2h}, but perhaps C_2^2. Symmetry requirements point to $n=2$ or perhaps 4 in the above formula. C. A. S.

1808. Liquid Crystals Obtained by Rapid Evaporation from Aqueous Solution. P. Gaubert. *Comptes Rendus*, 198. *pp.* 951–953, *March* 5, 1934.—Liquid crystals of tartrazine behave, from the point of view of artificial coloration, like substances obtained in a melt. Rapid evaporation takes place on a glass slip. F. I. G. R.

1809. Liquid Crystals. W. H. Bragg. *Roy. Inst., Proc.* 28. 1. *pp.* 57–92, 1933–1934. *Nature*, 133. *pp.* 445–456, *March* 24, 1934.—A fairly detailed discussion of the mesomorphic state (liquid crystals). The types considered follow the usual three main divisions: (1) smectic, in which a layer structure predominates, conditioned by the presence of families of Dupin's cyclides; the geometry of these is treated in considerable detail. Ethyl-p-azoxybenzoate is an example, which is smectic between 114° C. and 120° C. (2) nematic, giving a thread-like, imbricated structure, and mobility due to the ease of molecular displacement longitudinally. Examples are p-azoxyanisole (nematic range, 116° C.–133° C.) and p-azoxyphenetole (nematic range, 135° C.–165° C. (3) cholesteric, with extreme optical activity and brilliant coloration. Example, cholesteryl cinnamate (cholesteric range, 156° C.–197° C.). Finally, there are two appendices—one dealing with the path of the extraordinary ray, and the other with the passage of the polarised light through a helicoidal sheet. F. I. G. R.

1810. X-Ray and Optical Comparison of Anisotropic and Isotropic Melts of p-Azoxyanisole. W. Kast. *Ann. d. Physik*, 19. 5. *pp.* 571–581, *March*, 1934.—From the X-ray photographs and the course of the intensity relations, it seems that the molecular groups must be differently constructed in the two phases: the " swarms " in the normal melt being completely isotropic, but strongly anisotropic in the liquid-crystal. From the optical characteristics (birefringence, dichroism, dispersion) the molecular arrangement is concluded to have higher symmetry in the normal phase. This means that the molecules have lost their elongated form, which is essential for the appearance of the turbid modification. F. I. G. R.

1811. Structure of N-Alcohol Solutions of Lithium Chloride. G. W. Stewart. *J. Chem. Phys.* 2. *pp.* 147–152, *April*, 1934.—An X-ray study is made of concentrated solutions of LiCl in the three normal alcohols, ethyl, propyl and butyl. A definite but tentative conclusion is that in these concentrated solutions of a strong electrolyte, both Li^+ and Cl^- participate with the molecules of the solvent in forming a common liquid cybotactic or quasi-crystalline structure. This is a new conception which may be made to include what have been described as " ionic clouds " and as " association." A conclusion of secondary importance is that the solutions are in fact solutions of the alcoholates of LiCl, although above the corresponding transition temperatures. AUTHOR.

1812. Substances Modifying Crystal Faces on Deposition from Solution. L. Royer. *Comptes Rendus*, 198. *pp.* 949–951, *March* 5, 1934.—A note dealing with the effects of succinic acid, sodium nitrate, ammonium iodide upon mica (muscovite). The first-named is not orientated, whereas the other two are orientated. Conditions are briefly discussed. [See also Abstract 921 (1934)]. F. I. G. R.

1813. Cleavage Induced by Impurity. H. E. Buckley. *Zeits. f. Krist.* 88. *pp.* 122–127, *May*, 1934. *In English.*—Pure K_2SO_4, has two poor cleavages, on {010} and {004}. There is no cleavage whatever on {100}. When grown in the presence of Alizarin Yellow 5 G (colour index No. 122) there is a considerable modification of the habit, the 100 faces being enhanced. At the same time, there is a new cleavage developed on the 100 face. This cleavage is of a highly perfect nature and passes the highest test optically possible (that of giving interference lines in monochromatic light; in this respect it is as good as potassium ferrocyanide). It is shown that the property is developed by growth at the 100 surface. All regions in a crystal which have, at some period in the crystal's growth-history, been situated at a growing 100 surface, possess this cleavage, while portions which have passed into the interior of the crystal *via* some other face only exhibit the conchoidal fracture of the pure crystals. AUTHOR.

1814. Kinetics of Additive Discoloration of Alkali Halides. S. Arzybyschew. *Zeits. f. Physik*, 88. 3–4. *pp.* 260–264, *March* 19, 1934. —The work of Gurney on the discoloration of the alkali halides is corroborated. The discoloration process begins with escape of halogen ions from the crystal into the fluid alkali metal. Diffusion of the disrupted electrons into the crystal lattice takes place with the resultant change in colour of the salt. The system NaCl-Na is investigated and an energy level diagram is shown to illustrate the results obtained. [See also Abstract 3981 (1932).] H. J. H. S.

1815. Optics and Crystal Form of Alkali Zinc Uranyl Acetates. H. Insley and F. W. Glaze. *Bureau of Standards, J. of Research*, 12. *pp.* 471–474, *April*, 1934.—The optical properties and crystal form of the zinc uranyl acetates of sodium, lithium, and potassium were determined. The lithium and sodium zinc uranyl acetates belong to the monoclinic system and are isomorphous. They are capable of forming a series of solid solutions, as is evidenced by the homogeneity and the intermediate optical properties and X-ray pattern of a mixed sodium and lithium zinc uranyl acetate. The potassium zinc uranyl acetate belongs to the tetragonal system and differs from the lithium and sodium zinc uranyl acetates in optical properties and crystal form. AUTHORS.

1816. Properties of Crystalline Mercury. E. Grüneisen and O. Sckell. *Ann. d. Physik*, 19. 4. *pp.* 387–408, *Feb.*, 1934.—A determination is made of the density of mercury at − 191° C., the specific resistance at − 187·5° C., the mean coefficient of thermal expansion between − 188° C. and − 79° C., and the six principal elastic constants at − 190° C. Although mercury is strongly anisotropic with respect to its elastic properties it is only weakly anisotropic with respect to its thermal expansion. These two facts are theoretically explained. It is concluded that with falling temperature the coefficient of thermal expansion parallel to the trigonal axis must fall off more quickly than that perpendicular to the trigonal axis but no experimental proof is available. J. T.

1817. Alteration in Properties of a Deformed Single Crystal on Recovery. M. O. Kornfeld. *Phys. Zeits. d. Sowjetunion*, 5. 2. *pp.* 185–190, 1934. *In German.*—Previous work on the recovery of deformed polycrystalline materials [see Abstract 438 (1934)] is extended to the case of single crystals of Al. The relations between the limits of flow of the deformed crystal and the time and temperature of the recovery process are investigated. The results, which are in close agreement with those obtained previously, suggest that the alteration in the behaviour of a deformed polycrystalline material on recovery is dependent upon the recovery of the crystals composing it. H. J. H. S.

1818. Focalisation Method in X-Ray Analysis of Crystals. A. Rogozinski. *Comptes Rendus*, 198. *pp.* 953–955, *March* 5, 1934.—An arrangement designed essentially to reduce the time of exposure. A ring-system is employed, the direction of X-ray propagation being a focal line. Neither slit nor collimator is needed. The method is very suitable for substances with small lattice dimensions, and all points of the ring contribute equally in the formation of the focal spot. F. I. G. R.

See also Abstracts 2040, 2071, 2091, 2092, 2147, 2159, 2160, 2161, 2171, 2192, 2242.

DENSITY.

1819. Calculation of Specific Surface of a Powder. H. Heywood. *Inst. Mech. Eng., Proc.* 125. *pp.* 383–416; *Disc.*, 417–459, 1933. *Colliery Guardian*, 147. *pp.* 867–869, *Nov.* 10; 919–921, *Nov* 17, *and pp.* 963–964, *Nov.* 24, 1933.—Various properties of shape, area and volume of a single particle are first dealt with. Some of these are used in the derivation of an expression for the specific surface (or surface per unit mass) of a powder. The expression is independent of shape-constants. Data for substitution therein are derived from curves (obtained by sieving and elutriation) expressing the percentage by weight of particles larger than given diameters, and observations on the number, mass and diameter of a number of particles uniform in size. In the last part of the paper is considered an " exponential powder." The results are compared with data obtained from various powders met with in practice. P. H. B.

See also Abstracts 1770, 1771, 1778, 1781, 1816.

DIFFUSION AND OSMOSIS.

1820. Penetration of Electrolytes into Wood. O. Maass. *Canad. J. of Research*, 10. *pp.* 180–189, *Feb.*, 1934.—The rates of diffusion of NaOH, NaCl and HCl into chips of black spruce heartwood impregnated with water were measured for different shapes of chip at 20, 50, and 75° C. In the longitudinal direction of the wood, HCl diffuses the most rapidly and NaOH and NaCl at nearly the same rates. In the lateral direction NaOH diffuses the most rapidly, owing to its action on the wood. Concentration of electrolyte is practically without influence on the time to half-value for NaOH and HCl. The density of the wood does not affect the rate of diffusion of NaOH. The rate of diffusion of water into air dry chips was measured at 20 and 50° C. AUTHOR.

1821. Selectivity of Osmotic Diaphragms. L. L. Burgess. *Am. Chem. Soc., J.* 56. *pp.* 414–419, *Feb.*, 1934.—Colloidal diaphragms prepared by precipitation of sodium alginate, and soap or casein precipitated by Ca and Mg salts, favour diffusion of certain ions and retard others. This is attributed to adsorption. A. S. C.L.

See also Abstracts 1814, 2168.

ELASTICITY AND PLASTICITY.

1822. Elasticity of Brittle Materials. H. Schlechtweg. *Zeits. f. angew. Math. u. Mechanik*, 14. *pp.* 1–12, *Feb.*, 1934.—Hooke's law, tensorially expressed, is modified to cover the non-linear behaviour of brittle substances such as stone or cast iron. Three new constants are introduced, of which one is usually negligibly small; and all of which may be determined by experiments on tension and torsion. The new law is shown to describe satisfactorily the elastic behaviour of specimens of cast iron. J. P. A.

1823. Graphostatics of Stress Functions. H. M. Westergaard. *A.S.M.E. Trans.* 56. *pp.* 141–150, *March*, 1934.—Gives an account of the applications of " stress surfaces," the elevations of which above a horizontal plane represent stress functions associated with points in the plane. The problems considered are chiefly connected with stresses in slabs. Attention is directed to the use of analogous methods for solving special problems. J. P. A.

1824. Elastic Equilibrium in a Region Subjected to an Initial Tension. M. Biot. *Ann. Soc. Sci. de Bruxelles*, 54. *pp.* 18–22, *March* 20, 1934.—From the classical equations of elasticity the phenomena of instability cannot be deduced. Using Hooke's Law and purely geometrical considerations it is shown how to deduce for a body with initial tensions the equations of elasticity in a sufficiently simple form and to foresee the phenomena of instability. The method used is similar to Trefftz's but the order of approximation and the validity of the method when introducing the rotation, *w*, into the potential energy expression are specified. For the approximation considered, *w* plays a predominant part and has significance in the equation only when large compared with the deformations. The deformations satisfy Hooke's Law but the order of magnitude of *w* introduces new terms of the second power into the potential energy expression. The equations of elasticity deduced are different in form from those of Trefftz, but are equivalent to them to the stated approximation and can be interpreted easily in terms of statics. R. S. R.

1825. Equilibrium of Elastic Elliptical Plate. H. Ôkubo. *Phys. Math. Soc., Japan, Proc.* 16. *pp.* 77–84, *March*, 1934. *In English.*—The distribution of stress in an elliptical plate compressed along an axis is analysed by a mathematical process, as used in previous calculations for a circular plate [see Abstract 3900 (1933)]. J. P. A.

1826. P-V-T Data for Nitric and Nitrous Oxides. H. L. Johnston and H. R. Weimer. *Am. Chem. Soc., J.* 56. *pp.* 625–630, *March*, 1934.—Accurate measurements are made upon NO and N_2O, from their normal boiling points to room-temperature, and at pressures between 20 and 100 cm. of Hg, by a comparison with H_2, the gas in each case being contained in the bulb of a constant-volume gas thermometer. The second virial coefficients are calculated, and represented analytically and graphically as functions of the temperature. It is found that while Berthelot's equation represents molar volumes fairly well, it cannot be reliably employed for temperature derivatives of volume, in the case of NO. J. P. A.

1827. Bending of Marble. (Lord) Rayleigh. *Roy. Soc., Proc.* 144. *pp.* 266–279, *March* 29, 1934.—In an investigation of the considerable permanent flexure which sometimes results when a specimen of marble is supported horizontally, it is found that baking reduces the flexural rigidity, and increases the tendency to permanent flexure. An increase in the temperature of baking enhances these effects, while at the same time the marble becomes permanently elongated, its porosity increases and its strength diminishes. Tentative explanations are offered, based upon the unequal expansion of calcite crystals along different axes. J. P. A.

1828. Rubber Plasticity Control. J. H. Dillon. *Indust. and Engin. Chem.* 26. *pp.* 345–349, *March*, 1934.—Experiments are described to determine the practical value of the recovery measurement of the Williams plastometer in rubber plasticity control testing. It is stated that no conditions have been found where the recovery measurements yield any important practical information which cannot be gained by measurement of the " y " value alone. J. K.

1829. Compression Cutting Test for Rubber. W. L. Holt. *Bureau of Standards, J. of Research*, 12. *pp.* 489–499, *April*, 1934.—This paper describes a study of the compression cutting test, also referred to as the shear test, for rubber. The test consists of compressing a sample of rubber to failure between a flat plate or anvil and a cutting tool, and recording the relation between the thickness of the sample and the load up to failure. Data are presented on (1) different tools used for the test, (2) conditions affecting the results, and (3) a comparison of the compression cutting tests with other common tests. Advantages and disadvantages of the compression cutting test are discussed. The conclusion is reached that it is valuable as a supplement to, rather than as a substitute for, the tensile test. AUTHOR.

1830. Thermal Tensions in a Stationary Régime in Cylindrical Bodies, and Their Photoelastic Measurement. M. Biot. *Ann. Soc. Sci. de Bruxelles*, 54. *pp.* 14–18, *March* 20, 1934.—The cases of a solid and hollow cylinder are considered. It is proved that for a solid cylinder, where the section perpendicular to the axis is a simple connected surface and the temperature distribution is the same for all sections, that expansion occurs freely in the plane of the section. Relations are established for the resulting rotations and displacements. The results are extended to a hollow cylinder which may also have others concentric with it. To get free expansion with a stationary temperature distribution certain extra conditions for the rotation and expansion must then be satisfied. These relations are established and the application to the photoelastic measurements of the tensions is given. R. S. R.

1831. Shearing Disc Plastometer for Unvulcanised Rubber. M. Mooney. *Indust. & Engin. Chem.* (*Analytical Edition*), 26. *pp.* 147–151, *March* 15, 1934.—A plastometer for unvulcanised rubber is described in which the sample is sheared between the surfaces of a rotating disc and a stationary chamber surrounding the disc. In order to prevent slippage the rubber is kept under a confining pressure and the surfaces which shear it are roughened. The stator chamber is made in two sections which close together under the action of a powerful lever system, and in doing so they automatically cut and form the sample of rubber. A complete plasticity measurement, including heating the sample, can be made in 3 min. The measurement obtained, called the shearing viscosity, is proportional to the mean absolute viscosity of the sample. —AUTHOR.

1832. Improved Bourdon Gauge. S. G. Foord. *Journ. Sci. Instruments*, 11. *pp.* 126–127, *April*, 1934.

1833. Oil Manometer for Low Pressure. K. Hickman. *Kodak Research Lab., Comm. No.* 527. *Rev. Sci. Instruments*, 5. *pp.* 161–164, *April*, 1934.—An oil (ethyl or butyl phthalate) gauge suitable for pressures from 5 mm. to 0·01 mm. is described. The accuracy is greater than 0·001 mm. A. S. C. L.

See also Abstracts 1842, 1946, 2125, 2130.

GRAVITATION.

1834. Gravity and Hypothesis of Convection Currents. F. A. V. Meinesz. *K. Akad. Amsterdam, Proc.* 37. 2. *pp.* 37–45, 1934. *In English.*—Recent results show positive gravity anomalies over parts of the oceans, and in particular in all the deep basins in the tectonically active areas, *e.g.*, the Dutch East Indies. Such depressions are not explicable by synclinal folding and must be attributed to subsidence, whilst the anomalies are too great to be explained isostatically. The radioactivity of the lighter granites is 2–3 times that of the heavier basalts; granite predominates below the continents, basalt below the oceans, the beds of which are further cooled by the water. Temperature is therefore higher under the continents than at the same level under the oceans, and convection currents will be caused, reaching down to the discontinuity layer at 1200 km.

inferred from seismological results. By reason of the high viscosity and slow velocity of the material, it is shown mathematically that this leads to positive anomalies and descending currents (at a velocity of the order of 1 cm./ann.) under the oceans, and the reverse under the continents. Secondary but similar currents would also be developed by temperature disturbances accompanying tectonic processes. Such currents would also cause tangential stresses, and slips of the whole crust relative to the core of the earth. C. A. S.

1835. Isostasy in India, U.S.A. and Southern Canada. W. Bowie. *Gerlands Beitr. z. Geophys.* 41. 2. *pp.* 250–259, 1934. *In English.* —The paper describes a test of isostasy in India by means of a study of the isostatic gravity data made according to a plan adopted a few years ago for a similar study in the U.S.A. The country is divided into sections of nearly equal areas and the unequal distribution of stations is partly overcome by dealing with the mean anomalies for these sections rather than with those at individual stations. Maps illustrate the distribution of stations and areas in the three countries and the mean isostatic and Bouguer anomalies found. All anomalies are based on the Bowie formula, the Pratt hypothesis and a depth of compensation of 113·7 km. In each case the distribution of isostatic anomalies follows very closely that for accidental errors, but for Bouguer anomalies this is not the case and they have a bigger range. Comparison of the data shows that the isostatic condition of the crust under each of the three countries is very much the same.

R. S. R.

See also Abstracts 1921, 1922, 1926.

HYDRODYNAMICS AND AERODYNAMICS.

1836. Formation of Air Pockets. C. Popovici. *Comptes Rendus,* 198. *pp.* 439–441, *Jan.* 29, 1934.—A mathematical paper showing that a necessary (but not sufficient) condition for equilibrium in the steady movement of a fluid is the formation of a vacuum pocket around the position at which equilibrium is maintained. J. W. T. W.

1837. Aerodynamics of Stratosphere. A. F. Zahm. *Frank. Inst., J.* 217. *pp.* 153–166, *Feb.*, 1934.—Discusses the dynamics of very rare fluids in which the particles have very long free paths instead of the usual very short ones. The work is based on Newton's theory of a fluid consisting of discrete particles, either elastic or inelastic, moving in a steady uniform stream so as to create a pressure on the front surface of a body and leave a perfect vacuum behind it. Theoretical work is needed on the equations for the reaction of a fluid in which the free paths are neither very short nor infinitely long. J. W. T. W.

1838. Parallel Vortices and Their Points of Relative Rest. W. B. Morton. *Roy. Irish Acad., Proc.* 41*A*. 9. *pp.* 94–101, *Oct.*, 1933.—In continuation of previous work [see Abstract 4024 (1932)], the author discusses the motion of *n* equal vortices at the corners of a regular polygon with unchanged configuration, and examines the possible existence of liquid particles which move as if rigidly attached to this configuration. As particular cases, configurations having the form of an equilateral triangle or rhombus are treated. J. S. G. T.

1839. Integration of Hydrodynamical Equations for Incompressible Fluid by Heaviside's Method. H. Ertel. *Preuss. Akad. Wiss. Berlin, Ber.* 28. *pp.* 860–869, 1933.—The equations of disturbed motion are reduced to the linear form. It is shown that on very general assumptions, a solution can be obtained by Heaviside's operator calculus. The solution satisfies the continuity and boundary requirements. It may be applied to certain problems of meteorology and hydrodynamics. T. L. M.

1840. Geometry of Floating Vessel. E. Barrillon. *Comptes Rendus*, 198. *pp*. 449–452, *Jan*. 29, 1934.—A mathematical treatment of the geometry of a boat floating freely or aground and empty or containing liquid. The treatment follows the method of metacentres. J. W. T. W.

1841. Equations of Movement of a Fluid Holding Particles in Suspension. M. Biot. *Ann. Soc, Sci. de Bruxelles*, 54. *pp*. 22–24, *March* 20, 1934.—The case is taken of a cube in the fluid to which acceleration is given parallel to one edge and an equation is developed for the pressure gradient in terms of the hydrostatic pressure, the relative acceleration of the particles and the viscosity of the particles in relative motion. It is shown that in the case of a fluid with small viscosity, the vorticity varies from point to point in a way depending upon the variation of speed at the initial instant and a variation of vorticity has a tendency to be maintained. R. S. R.

1842. Oscillations in High-Speed Jets of Compressible Fluid. S. G. Hooker. *Phil. Mag*. 17. *pp*. 651–660, *March*, 1934.—The jets photographed by Hartmann [see Abstract 2747 (1931)] have been measured and the results used to test Prandtl's theoretical explanation of the periodic structure of these jets [see Abstract 3 (1905)]. Regarding the origin of the oscillations, at the moment of leaving the nozzle, the jet enters a region of pressure lower than that of the static pressure in the jet, and accordingly experiences a sudden increase of expansion with the result that oscillations are developed. G. E. A.

1843. Thermoelectric Flowmeter. A. Égal. *Comptes Rendus*, 198. *pp*. 1134–1137, *March* 19, 1934.—In an earlier paper [see Abstract 5154 (1933)] the author has described a thermoelectric method of measuring the flow of liquids. A method of compensating for errors due to surrounding temperature variations in now described. J. E. R. C.

1844. Photographs of Fluid Flow Revealed with an Ultramicroscope. A. Fage. *Roy. Soc., Proc*. 144. *pp*. 381–386, *March* 29, 1934.—The ultramicroscope has recently been used to examine turbulent flow in pipes, and to obtain information on the eddying wake behind a bluff obstacle. Photographs are given in the paper of some of the views seen when this earlier work was in progress; also of the flow around a circular cylinder at low Reynolds number. The flows were revealed by the motions of those minute particles in water which became visible in the light beam of the ultramicroscope. AUTHOR.

1845. Displacement of Water Associated with Submarine Explosions. J. Ottenheimer. *Comptes Rendus*, 198. *pp*. 893–896, *March* 5, 1934.—In continuation of previous work [see Abstract 4026 (1932)] the author has investigated the displacement of water occasioned by a submarine explosion, precautions being now taken to prevent the possibility of the results being complicated by reflections and the retention of gaseous products of the explosion. The displacement of the water surface is now found to correspond to a damped oscillation; previously the second wave was found to have the greatest amplitude. J. S. G. T.

KINETIC THEORY OF MATTER.

1846. Molecular Rays. E. Persico. *N. Cimento,* 11. *pp.* 118–132, *Feb.,* 1934.—A succinct *résumé* of what, thanks mainly to the labours of Stern of Hamburg, is known about molecular rays, *i.e.,* successions of independent molecules, following one another through a vacuum in one and the same straight line. The author discusses the production of these rays—allowing gas or vapour to escape from a reservoir into a vacuum through an aperture, and picking off those molecules which traverse another aperture into another vacuum; the modes of detecting these rays; the measurement of the mean velocity; magnetic and electric deviations of the rays; diffraction of the rays; and various applications. A. D.

1847. Distribution of Velocities in Brownian Movement. G. Krutkow. *Phys. Zeits. d. Sowjetunion,* 5. 2. *pp.* 287–300, 1934. *In German.*—A relation is deduced between the distribution-coefficients for a time t and for a time $t+\tau$. Solution of the integral and a discussion of a limiting case are given. Experimental determination is made of a function remaining undetermined. Another form is deduced for the differential equation, applicable to any value of τ. The probability of a transition and relation to the Einstein-Fokker equation is considered. Mean data are given. A. D.

1848. Distribution Functions in Brownian Motion. L. S. Ornstein and W. R. van Wijk. *Physica,* 1. *pp.* 235–254, *Feb.,* 1934. *In English.*—The distribution functions of velocity and displacement in the Brownian motion of a free, and of a harmonically bound particle are derived by integration of the equation of Langevin. The results are extended so as to include the influence of an external force, dependent on the time. The relation between the distribution function and a second-order partial differential equation of the parabolic type is discussed. AUTHORS.

1849. Mobility of Small Selenium Particles with Great Velocities in Air. A. S. Berkowitsch. *Helv. Phys. Acta,* 7. 2. *pp.* 170–202, 1934. *In German.*—By discharge of a condenser, initially charged to a high potential, through a Millikan condenser and a parallel resistance, small Se particles in suspension are subjected to a very strong electric field and in consequence attain for a short time great velocities. It is shown that under such conditions the simple law of motion $v = bK$ holds good and that the mobility b for this non-uniform motion agrees within 1 % with the mobility B for slower uniform motion. For Se particles of 7 to 15×10^{-5} cm. radius it was found that for great velocities in air Millikan's law is applicable, with $b = (1/6\pi\mu a)\cdot(1 + A'l/a)$. A′ is itself a function of l/a of the form $A' = A + Be^{-ca/l}$. The mean value of A found from 13 series of measurements was $A = 0\cdot875 \pm 0\cdot035$. A. W.

See also Abstract 2104.

LENGTH (STANDARDS, MEASUREMENTS, APPARATUS).

1850. Use of Cadmium Red Radiation as a Standard in Metrology and Spectroscopy. C. Fabry. *Comptes Rendus,* 198. *pp.* 861–864, *March* 5, 1934.—Objection is raised to a statement by Pérard [see Abstract 1584 (1934)] that the possibility of self-reversal in the red radiation of Cd disqualifies it from future use as the fundamental unit of length. In the author's opinion all radiations are reversible, but they can

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be produced without reversal by suitable control of the conditions of excitation. The paper includes a discussion of the question of adopting a wave-length of light as the international unit of length, and draws attention to the possibilities of radiations of Kr and Xe as suitable standards in addition to the red line of Cd. H. B.

MATHEMATICAL METHODS. THEORY OF MEASUREMENTS. UNITS AND DIMENSIONS.

1851. Harmonic Analysis. P. Terebesi. *Arch. f. Elektrot.* 28. *pp.* 195–200, *March* 15, 1934.—The author describes a new method of harmonic analysis, using two auxiliary series C and S derived from the integration of each term in the wave-form multiplied by the series representing a square wave-form of the same frequency. The method is modified for use with a planimeter. L. E. C. H.

1852. Change of Variables in Laplace's and Other Second-Order Differential Equations. T. Smith. *Phys. Soc., Proc.* 46. *pp.* 344–349, May 1, 1934.—Transformations of variables are expressed as matrix products, the effect of transposition being particularly considered, and the results applied to the transformation of the general second-order differential expression. AUTHOR.

1853. Integrals of Products. T. Smith. *Phys. Soc., Proc.* 46. *pp.* 365–369 ; *Disc.*, 369–371, May 1, 1934.—The integral of a product of quantities known only for discrete values of a variable is given correctly by the simple sum of the products for uniformly distributed values of the variable. Nothing is gained by increasing the number of component products beyond the number of observed values of either factor. AUTHOR.

1854. Least-Squares Solutions without Normal Equations. F. Schlesinger. *Astron. J. No.* 1004. *pp.* 89–92, *Feb.* 28, 1934.—The method is based on the correction of approximate values of the unknowns. For the normal equations products involving the residuals are zero ; the correction is the quotient of the residual product for the approximate values by the diagonal term. Three applications are given, including a parallax problem and orbit of a minor planet. The method saves much time for many unknowns, provided these are well separated by the observations ; a device is given for dealing with the case where two unknowns are markedly correlated. The author mentions cases where the method is unsuitable ; skill may be required to decide whether to use it. T. L. M.

1855. Errors in the Closing of Polygonal Lines and Their Laws of Frequency. A. Paroli. *Ricerche di Ingegneria*, 2. *pp.* 1–15, *Jan.–Feb.*, 1934.—The errors in the closing of a polygon are expressed as functions of its geometrical elements and of coefficients experimentally determinable. By means of statistical partition of the errors of a system of polygons, the author verifies the agreement between the mathematical and effective frequencies and between their theoretical and concrete distributions with respect to the ellipse of error, applying then the results obtained to the critical study of the limits of admissibility. A. J. McC.

1856. Measurement of Trains of Polygons. K. Ulbrich. *Zeits. f. Instrumentenk.* 54. *pp.* 118–126, *April*, 1934.—The paper is not suitable for abstracting. Closing errors obtained from optical and direct methods of measuring the sides of secondary polygon trains are compared, and discussed in relation to the official limits for errors in the deviation of length. W. A. R.

1857. Two New Properties of Mathematical Likelihood. R. A. Fisher. *Roy. Soc., Proc.* 144. *pp.* 285–307, *March* 29, 1934.—Reasons are given for the use of mathematical likelihood in problems of inductive inference. When a statistic exists, satisfying the criterion of sufficiency, the likelihood function involves only that statistic. An example is given of a sufficient statistic, and its sampling distribution is expressed in terms of the likelihood function. This property is generalised for all cases of simple estimation, where a sufficient statistic exists. It is shown that these cases and only these supply tests of significance of the kind termed by Neyman and Pearson " uniformly most powerful " with regard to a class of alternative hypothesis. Where no sufficient statistic exists the precision of estimation may in general be enhanced by the use of ancillary statistics. A class of cases is defined and illustrated in which the totality of the ancillary information supplied by the observations may be utilised. This process gives a very simple derivation of sampling distribution, in which there is no loss of information, even for small samples. AUTHOR.

1858. Smoothing and Differentiation of Tables. H. Jeffreys. *Cambridge Phil. Soc., Proc.* 30. *pp.* 134–138, *April* 30, 1934.—A method of smoothing, suitable for the case in which there are available values of y for five equally spaced values of x, is discussed. It is shown how the two terminal pairs of values of y, which are lost in taking fourth differences, can be replaced. The method of smoothing makes very little difference to the standard error ; if the original values of y have standard error σ, smoothing reduces it to $0\cdot 7\,\sigma$, but the standard error of the first differences is reduced by more than 50 %. A suitable technique for applying this method of smoothing is described. J. S. C.

1859. Interconversion Scale for Energetic and Related Magnitudes in the Electromagnetic Wave-Band. C. H. D. Clark. *Leeds Philosoph. and Lit. Soc., Proc.* 2. *pp.* 513–518, *Jan.*, 1934.—The author describes a convenient calculating rule or scale which enables one to read off the values of nine of the following ten interrelated magnitudes, given the value of one of them ; wave-length in Å, frequency in c.p.s., p.d. in electron volts, electron velocity v in cm./sec., energy in ergs, heat H in cal. or U k.cal./mol., mass in gm. and temperature in °Abs. The scale covers a range extending from very long waves (10^{20} Å) to cosmic rays of wave-lengths, 10^{-7} Å. The accuracy of the conversions is about 3 %. Several examples show the use of the scale in making rapid calculations of the energetics of atomic processes. W. S. S.

See also Abstract 1974.

MECHANICS, CLASSICAL.

1860. Centres of Gravity of Finite Homogeneous Bodies. P. Vincensini. *Comptes Rendus*, 198. *pp.* 891–893, *March* 5, 1934.—The author discusses some properties of the orthobaric directrices, a term used by Levi-Civita, and of the surfaces discussed by Trincomi in connection with the centres of gravity of the ∞^3 plane sections of a finite homogeneous body. J. S. G. T.

1861. Foundations and Analytical Methods of Statistical Mechanics. H. Gebelein. *Ann. d. Physik*, 19. 5. *pp.* 533–570, *March*, 1934.—An investigation, based upon the work of v. Mises and Kolmogoroff, into the relation between classical and statistical mechanics, and into the analytical methods used in certain problems of statistical mechanics. The problem of ' stochastic ' systems of one degree of freedom is first discussed followed by a treatment of the general case of *n* degrees of freedom. A. J. McC.

See also Abstract 1849.

MECHANICS, QUANTUM.

1862. Dirac's Theory of the Magnetic Electron. L. de Broglie. *Arch. des Sciences*, 15. *pp.* 465–483, *Nov.–Dec.*, 1933.—The author gives a lucid outline of wave mechanics both in its original form and according to Dirac's theory of the electron which resulted from the attempt to harmonise the quantum theory with relativity. It is observed that even in the Dirac theory, physical quantities are still to be regarded as capable of assuming only selected or eigenvalues and it is only when the mean values (or more correctly the mean value densities, *i.e.*, the quantities which when integrated throughout space give the mean values) are introduced, that the use of the tensor transformations characteristic of relativity theory is restored. Again, in the Dirac theory the time coordinate continues to occupy a special position (this is implicit in the notion of stationary or eigenvalues), and the fundamental tendency of relativity is to submerge differences between the space and time coordinates. However, complete equivalence of space and time is not attained in classical relativity; owing to the persistence of material particles, space-time presents a fibrous structure in the direction of time. W. S. S.

1863. Elementary Notions of Quantum Mechanics. K. K. Darrow. *Rev. Modern Physics*, 6. *pp.* 23–68, *Jan.*, 1934.—A simple introductory survey starts from the fundamentals of corpuscular and undulatory theories, and shows the steps in the fusion of these two. Heisenberg's uncertainty principle and the concepts of wave mechanics, wave equations, and Schrödinger's equation are described, followed by applications of the latter to stationary states of atoms and the linear harmonic oscillator. Vibration frequencies of a classical atom model, and term and emission frequencies of a quantum mechanical model are considered. Matrix algebra, its application to quantum mechanics, and the use of operators are described. N. M. B.

1864. Relativistic Quantum Interaction. K. Nikolsky. *Comptes Rendus*, 198. *pp.* 1013–1015, *March* 12, 1934.—Wave mechanical interaction problems are treated on a correspondence principle based on the Poisson bracket expression. The method is illustrated for a classical system of two electrons, and gives equations enabling the mutual magneto-electric energy of two electrons to be found. The method gives a simple derivation of quantum formulæ from the corresponding classical formulæ. N. M. B.

1865. Relativistic Theory of Atoms Containing Many Electrons. J. Solomon. *Comptes Rendus*, 198. *pp.* 1023–1025, *March* 12, 1934.—The author directs attention to a difficulty encountered in Jensen's development [see Abstract 3363 (1933)] of the relativistic generalisation of the Thomas-Fermi electron theory, *viz.*, that all the electrons would ultimately fall into the nucleus. The difficulty is resolved if it be assumed that the Thomas-Fermi method is not applicable in the immediate neighbourhood of the nucleus. J. S. G. T.

1866. Relativistic Basis of Quantum Theory. H. T. Flint. *Roy. Soc., Proc.* 144. *pp.* 413–424, *March* 29, 1934.—The paper gives a relativistic treatment of the second-order equation of the quantum theory.

This equation turns out to be the curvature equation in the system proposed, corresponding to the equation of the theory of relativity, $G_{\mu\nu} = 4\lambda$. The basis of the work is a modification of the Riemannian co-variant operator and it is shown that the geometric background of the theory permits of some latitude. For this reason an appeal is made to geometrical methods to obtain an indication of the form of the equations but no special theory of parallelism is introduced directly. The relation to the matrix theory, especially in the form recently developed by Schrödinger is discussed and the two theories are found to be in harmony. The equation proposed is invariant and throws light on the kind of invariance appropriate to the quantum theory. It is, moreover, an advance on previous equations in that it contains terms appropriate to the gravitational and electromagnetic fields, which come in only with difficulty in other methods. AUTHOR.

1867. Approximate Derivation of the Wave Functions of Penetrating Orbits. V. Fock. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 1·5. *pp.* 241–247, 1934. *In German.*—The valency electron in a central atomic field moves in a penetrating orbit if the principal quantum number n is very large, the azimuthal quantum number small or zero. Two approximate solutions for the radial wave function appropriate to such orbits are obtained. One solution is valid up to a certain mean distance r_m and the other for greater values of r up to $r = \infty$. It is possible to fit the two solutions together at the distance r_m to obtain a single consistent solution. It is shown that in certain cases the original Bohr quantum condition employing integral quantum numbers corresponds to the wave mechanics solution, the half-quantum number rule of Kramers breaking down in such cases. W. S. S.

1868. Physical Significance of Multiple Times in Quantum Electrodynamics. F. Bloch. *Phys. Zeits. d. Sowjetunion,* 5. 2. *pp.* 301–315, 1934. *In German.*—Attention is directed to an analogy between the wave function occurring in the quantum-electrodynamic theory due to Dirac, Fock and Podolsky and that occurring in ordinary wave mechanics. The condition of integrability of the field equations and the significance of time in the theory are briefly discussed. J. S. G. T.

1869. Integration of Dirac Equations. M. Loève. *Comptes Rendus,* 198. *pp.* 799–801, *Feb.* 26, 1934.—The expression for the wave function characterising the motion of a particle in the absence of an external field is treated, and the interpretation of the results is discussed. N. M. B.

1870. New Method of Integrating the Equation for Electromagnetic Waves and its Application to the Electron. R. Reulos. *Comptes Rendus,* 198. *pp.* 1015–1018, *March* 12, 1934.—A vector method leading to Maxwell's equations, and, in the case of the electron, independent of any theory of electron structure, is deduced. N. M. B.

1871. Derivation of the Laws of Electrodynamics from Certain Solutions of the Equation for Electric Waves. R. Reulos. *Comptes Rendus,* 198. *pp.* 1137–1139, *March* 19, 1934.—Since the Coulomb law of force is probably invalid if the two elements of electricity are not at rest, derivations are made, based on wave mechanics, which are valid for variable currents and for electrons of any speed. *Errata, ibid. p.* 1280, *March* 26, 1934. N. M. B.

1872. Born's Theory of the Electron. P. Jordan. *Naturwiss.* 14. *pp.* 214–218, *April* 6, 1934.—The author reviews briefly the classical theory of the electronic field, Mie's theory of electronic structure and the interelectronic field, and Born's theory of the electron in which a finite value is derived for the electronic energy [see Abstract 487 (1934)]. J. S. G. T.

See also Abstracts **1946, 2014, 2035, 2036, 2037, 2082, 2112, 2145, 2147, 2179.**

RELATIVITY AND ETHER.

1873. Axiomatic Definition of Momentum and Energy. V. Lalan. *Comptes Rendus*, 198. *pp.* 1211–1213, *March* 26, 1934.—Two pairs of particles are considered in special relativity, the particles being all of equal mass. Each pair moves along one of two perpendicular straight lines. The velocities of the two particles forming a pair are equal and opposite and the velocities have the same values for both pairs. Under these conditions the momentum and energy of the pairs remain equal whatever the frame of reference may be. G. C. McV.

1874. New Geometrical Representation of the Lorentz-Einstein Transformation. S. Shimasaki. *Phys. Math. Soc., Japan, Proc.* 16. *pp.* 106–110, *March*, 1934. *In English.*—There are given, in the first place, two common values which are independent of the reference system, by introducing T (imaginary) and Φ (real), such as $ict=T$ and $-\frac{v}{c}=\sin\Phi$; and in the second place, a new geometrical representation of the Lorentz-Einstein transformation by using T (defined as $ct=T$) and the above Φ. Further the proper time, the contraction and the common values will find their meanings in this representation. AUTHOR.

1875. Foundations of the New Field Theory. M. Born and L. Infeld. *Roy. Soc., Proc.* 144. *pp.* 425–451, *March* 29, 1934.—The new field theory [see Abstract 487 (1934)] can be regarded as a revival of the idea of the electromagnetic origin of mass. The field equations are derivable from the postulate that there exists an "absolute field" which is the natural unit for all field components and the upper limit of a purely electric field. From the standpoint of relativity transformations, the theory can be founded on the assumption that the field is represented by a non-symmetrical tensor, a_{kl}, and that the Lagrangian is the square root of its determinant; the symmetrical part of a_{kl} represents the metric field, the anti-symmetrical part the electromagnetic field. The field equations have the form of Maxwell's equations for a polarisable medium. The laws of conservation of energy and momentum can be deduced. The static solution with spherical symmetry corresponds to an electron with finite energy (or mass); the true charge can be considered as concentrated at a point, but a free charge with a spatial distribution law can also be introduced. Motion of the electron in an external field obeys a law of Lorentz type. The force decreases for alternating fields of short wave-lengths of the order of the electronic radius; this accords with observations of the penetrating power of high-frequency (cosmic) rays. J. S. G. T.

1876. Materialisation of Polarised Ether. V. Posejpal. *Comptes Rendus*, 198. *pp.* 914–916, *March* 5, 1934.—In continuance of an earlier paper [see Abstract 1317 (1934)] the interior of atoms and molecules is imagined to contain particles of ether so strongly polarised that they are fixed in position in the atom, forming a shell of polarised ether within the atom. The presence of this shell is connected with the formation of positrons and electrons by materialisation of the ether particles on impact with a photon. J. E. R. C.

SOLUTION.

1877. Cryoscopic Determination of the Degree of Hydration of the Ions of Strontium Chloride in Aqueous Solution. E. Rouyer. *Comptes Rendus*, 198. *pp*. 1156–1158, *March* 19, 1934.—By determining the cryoscopic constants in salt solution and in pure water, as observed with resorcinol, and allowing for the polymerisation of the resorcinol [see Abstract 3198 (1933)], the apparent degree of hydration of $SrCl_2$ in aqueous solution (expressed in mols of H_2O per mol of $SrCl_2$) is found to be 26·72 in 0·5 *M* solution and 30·3 in 0·25 *M* solution. L. A. W.

1878. Statistical Interaction Between Ions and Molecules in Media of Small Dielectric Constant. O. Halpern and P. Gross. *J. Chem. Phys.* 2. *pp*. 184–187, *April*, 1934.—In this paper the general theory of the interaction between ions and molecules in solution is discussed with particular reference to the theory of Debye on the salting-out effect. The formulæ are applied to the dissociation equilibrium of an electrolyte in a medium of low dielectric constant. [See following Abstract.] AUTHORS.

1879. Electrolytes in Media of Small Dielectric Constant. P. Gross and O. Halpern. *J. Chem. Phys.* 2. *pp*. 188–192, *April*, 1934 —The authors give a general summary of some recent theoretical views concerning the characteristic features of electrolytes in media of small dielectric constant. After a discussion of conductivity observations in water-dioxane mixtures, previous attempts for their theoretical interpretation are criticised. It is shown that, in agreement with previously proposed views of the authors, the experimental data can be qualitatively and partly quantitatively understood by considering the activity-coefficient arising from ion-dipole interaction. [See preceding Abstract.] AUTHORS.

1880. Vapour-Liquid Equilibria in the System Nitrogen-Water. A. W. Saddington and N. W. Krase. *Am. Chem. Soc., J.* 56. *pp*. 353–361, *Feb.*, 1934.—The solubility of N_2 in water under pressure passes through a minimum between 70 and 80°C. Solubility increases with pressure but not in accordance with Henry's law. A. S. C. L.

1881. Solubility of Strong Electrolytes in Concentrated Solutions. G. Åkerlöf and H. C. Thomas. *Am. Chem. Soc., J.* 56. *pp*. 593–601, *March*, 1934.—The relationship between the thermodynamic activities of strong electrolytes are discussed and applied to some measurements of the solubility of silver sulphate in pure and mixed aqueous solutions of sulphuric acid and sulphates. From the results a general method for the calculation of the composition of the solution phase of three component systems with two strong electrolytes is deduced and discussed. F. J. B.

See also Abstracts 1779, 1794, 1811, 2168.

SURFACE TENSION AND COHESION.

1882. Capillary Penetration of Fibrous Materials. R. L. Peek, Jr., and D. A. McLean. *Indust. & Engin. Chem.* (*Analytical Edition*), 6. *pp*. 85–90, *March* 15, 1934.—This paper is a study of the penetration of liquids into porous materials, with special reference to the use of capillary rise in strips of fibrous materials as a test method for the evaluation of the penetration tension of the liquid-solid system (the penetration tension being the product of the surface tension and the cosine of the contact angle). It is shown theoretically that the rate of rise dh/dt varies linearly with the reciprocal of the height of rise, $1/h$, and that the slope of the

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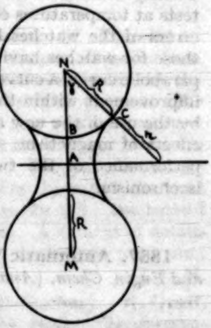
straight line obtained by a plot of these quantities is proportional to γ/η, where γ is the penetration tension and η the viscosity of the liquid. The proportionality constant is shown to be dependent not merely on the average pore size, but on the extent of the range of pore sizes represented. Using a single solid medium, therefore, relative values of the penetration tension for various liquids may readily be determined. Experimental data supporting the theory are presented. AUTHORS.



1883. Determination of Capillary Constant by Means of Two Spherical Segments. J. Versluys. *K. Akad. Amsterdam, Proc.* 37. 2. *pp.* 45–46, 1934.—If R is the radius of the spheres (see figure), r the radius of curvature of the liquid held between them by capillarity, γ the angle BNC, and σ the surface tension of the liquid, the force, P, required to break the connection between the spheres is shown to be very approx. $=\pi R\sigma(2-\pi/2.\sin\gamma)$, or if γ is small, $\pi R\sigma(2-\pi r/2R)$. This, if $R = 30$ c.m. $r \not> 0\cdot5$ cm., and the liquid be water, is of the order 14 g. ($= 14\cdot04$, $14\cdot003$, and $13\cdot856$ g. if $r = 0$, $0\cdot1$ and $0\cdot5$ cm. respectively). This gives a convenient means of determining σ, or by using spheres of different materials, enables the phenomena of wetting to be investigated. [See *De Capillaire Werkingen in den Boden.* **J. Versluys.** *Amsterdam*, 1916. *pp.* 78–83.] C. A. S.

1884. Method for Measuring the Surface Tension of Liquids. A. Achmatov. *Kolloid Zeits.* 66. *pp.* 266–270, *March*, 1934.—This method depends on measurement of the capillary over-pressure (p) of a drop of the liquid introduced into a conical capillary; $\sigma = k_1 p$, where k_1 is an apparatus constant. Measurements of the surface tensions of a series of liquids with the arrangement described gave accurate results. A second procedure, by which measurement of the pressure may be avoided, is also described. This involves determination of the drop-weight and measurement of the angle of inclination of the capillary to the horizontal. T. H. P.

See also Abstract 2182.

TIME (STANDARDS, MEASUREMENTS, APPARATUS).

1885. Personal Equation Apparatus for Prism Astrolabe. (Mrs.) E. Chandon, R. de Volontat and A. Gougenheim. *Bull. géodesique, No.* 40. *pp.* 285–305, *Oct.-Nov.-Dec.*, 1933.—The problem is to determine the absolute personal equation, defined as time between phenomenon and movement of chronograph pen, and thus affected both by the observer's reaction time and the arrangement of the apparatus. A number of devices are described and tested; the general principle is that of an artificial star which makes a direct chronograph record while the observer operates another recording pen. Of devices using a collimator and the astrolabe itself, that of Jobin and Yvon is most satisfactory. Of direct vision apparatus, that of Hurault and Chasselon and that of Claude and Driencourt are found efficient. Improvements are proposed in all cases. T. L. M.

1886. Comparison of Watches with Elinvar and with Steel Hairsprings. R. E. Gould. *Bureau of Standards, J. of Research,* 12. *pp.* 451–457, *April,* 1934.—The performance of watches having the usual cut, bimetallic balance wheels and steel hairsprings is compared with that of watches having uncut, monometallic balance wheels and elinvar hairsprings. The latter combination of vibrating assembly is a new application intended to improve the general performance of watches. Twenty watches of each type, 10 each of 2 makes, were given performance tests at temperatures encountered in ordinary use. The temperature-rate errors of the watches having the new vibrating assembly were less than those for watches having the ordinary assembly, and instead of the usual parabolic curve, a curve approaching a straight line was obtained. Marked improvement within the usual temperature range 0° to 50° C. is indicated by the use of the new assembly, which also almost entirely overcomes the effects of magnetism. There is no evidence of any marked difference in performance of the two types of watches in different positions or for isochronism. AUTHOR.

VACUA, HIGH.

1887. Automatic Vacuum Regulator. G. F. Liebig, Jr. *Indust. and Engin. Chem.* (*Analytical Edition*), 6. *p.* 156, *March* 15, 1934.

See also Abstract 2096.

VISCOSITY, FRICTION AND LUBRICATION.

1888. Viscosities and Vapour Pressures of Liquids. E. W. Madge. *Physics,* 5. *pp.* 39–41, *Feb.,* 1934.—A critical examination of the close parallel known to exist between the temperature variations of the vapour pressure p, and of $(1/\eta)$ where η is the viscosity, with particular reference to the formulæ $\log p = A' - B'/T$ and $\log (1/\eta) = A - B/T$. The bearing of recent work on these formulæ is considered, the physical interpretation of the constants pointed out and the question whether a more complicated equation is required, discussed. A new method of calculating a characteristic frequency to be associated with the latent heats of vaporisation and of cohesion is shown to result in numbers agreeing with those obtained from Lindemann's formula. J. P. A.

1889. Relation between Temperature Coefficient of Viscosity and Association of High-Molecular Liquids. B. Yamaguchi. *Tokyo Univ. Aeronaut Research Inst., Report No.* 102. *pp.* 229–252, *Feb.,* 1934. *In English.*—Measurements were made of the viscosities of benzene solutions of various high-molecular liquids. By means of Staudinger's equation, which expresses the relation between the viscosity and the concentration of solution, the " viscosity association " was calculated for a number of high-molecular liquids. A simple relationship exists between the temperature coefficient of viscosity and the viscosity association of high-molecular liquids. The relation between the temperature coefficient of viscosity and the molecular structure of high-molecular liquids is discussed. AUTHOR.

See also Abstract 1831.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

See Abstracts 1885, 2024, 2230.

COMETS AND METEORS.

1890. Mechanism of Cometary Phenomena. A. Dauvillier. *Bull. Astronomique*, 8. 4. *pp.* 213–220, 1933.—The electron emission from the sun is much more intense than the thermal radiation measured by the solar constant; but is deflected by the magnetic fields of planets. The part of the cometary nucleus facing the sun is raised to a high temperature. Gases occluded in the meteorites which compose it thus escape; and are completely ionised by the solar Lyman radiation. The phenomena are then comparable to those of a Crookes tube. The liberated electrons follow the lines of force in the field set up, and form the tail; the ionised molecules give the envelope surrounding the nucleus. A number of details are discussed: gradual loss of tail; contraction of nucleus near sun; multiple and changing tails; etc. T. L. M.

1891. Photometry of Comet 1932*n* (Dodwell-Forbes). K. Graff. *Akad. Wiss. Wien, Ber.* 142. 2*a*. 9–10. *pp.* 445–448, 1933.—The observations are 26 eye estimates and 9 measures against slightly extra-focal star images. They are fully discussed and systematic differences between the series calculated and accounted for. The brightness at unit distance from earth and sun, and variation with increasing distance are computed. The observations are very well satisfied; the author stresses the value of eye-estimates of suitable comets. The decrease of brightness with distance was very rapid. T. L. M.

COSMOGONY.

1892. Universe and Atom. H. Weyl. *Naturwiss.* 22. *pp.* 145–149, *March* 9, 1934.—A summary of theories regarding the geometry and expansion of the universe; and the relation between the electron and the radius of the universe. T. L. M.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

1893. Problem of Three Bodies. K. Bohlin. *Astron. Iakttagelser och Undersökning, Stockholms Obs.* 11. 11. [30 pp.], 1934. *In French.*—The case considered is that of three bodies of equal mass, in the same line at the commencement of motion, when AB = 2 and BC = 1. The author summarises the motion in four plates. The outer orbit becomes nearly parabolic, the inner, after violent changes, highly eccentric. The aphelia of the interior orbit lie approximately on a circle. The perihelia of the outer orbit are near a neighbouring circle. Commencing from the assumption that these two quantities are constant, the author investigates more precise invariants of the motion. Conclusions are drawn for the planetary problem. The relation of the principle of conservation of Keplerian motion to this problem is discussed. T. L. M.

See also Abstract 1854.

LATITUDE AND LONGITUDE.

1894. Fluctuation of Greenwich Meridian. J. Xanthakis. *Bull. Astronomique*, 8. 3. *pp.* 123–130, 1933.—Displacements of the pole produce small variations in the meridian, hence a small error in the right ascension of stars in transit. This may become observable for close circumpolar stars; and would affect the constant *n* of the Bessel formula. Observations made at Strasburg in 1931 appear to show this effect from month to month. The 14 month period which is superimposed on the annual variation would produce a longer fluctuation; this is examined and tabulated for 7 stars from 1893 to 1931. This effect is not eliminated as between observations at superior and inferior culmination. T. L. M.

NEBULÆ.

1895. Distribution of Spectral Types in Dark Clouds. H. Brück. *Zeits. f. Astrophysik*, 8. *pp.* 75–81, *Feb.*, 1934.—If one compares the distribution of stars within various spectral groups and brightness regions in an absorbing field with the corresponding distribution in a neighbouring normal field, the effect of absorption is apparent as a displacement of the distribution numbers along the brightness scale. This effect is very poorly defined in the case of A stars and under certain conditions also in G stars, so that especially in the latter case an exact determination of the absorption and distance of the absorbing clouds is impossible. An investigation of the Kohlensack and of Field 194 of the Selected Areas reveals no sign of a displacement effect and hence no indication of the presence of absorption in the Kohlensack. An explanation is sought for this effect. An estimate shows that the absorption in the region between $H\gamma$ and $H\epsilon$ must be less than $0{\cdot}2^{m\cdot}$ to $0{\cdot}3^{m\cdot}$ J. E. K.

PLANETS.

1896. Variability of the Outer Planets and Correlated Phenomena. W. Becker. *Preuss. Akad. Wiss. Berlin, Ber.* 28. *pp.* 839–859, 1933.—Photometric observations of Mars, Jupiter, Saturn, Uranus, and Neptune are reduced to Harvard scale and mean opposition, and tabulated. Published observations as well as the author's are used. The period covered is from 70 to 90 years. The curves show variations of about ½ magnitude. Mars shows irregular pointed maxima, no period obtainable; Jupiter, a period of about 11½ years, similar to that obtained from belts, etc.; Saturn, great irregularity, and some correlation with white spots; Uranus, orbital period, with 8½ year period superimposed, and sudden changes in short periods; Neptune, more doubtful period of 21 years. Albedo and colour index are discussed. T.L.M.

1897. Long Period Inequality in Mean Motion of Pluto. H. Roure. *Comptes Rendus*, 198. *pp.* 901–902, *March* 5, 1934.—The mean annual motion of Pluto does not differ greatly from one-third of that of Uranus; an expression is found for the resulting inequality. The period is 6516 years. The corresponding term in the longitude of Uranus is unlikely to be observable. T. L. M.

See also Abstracts 1913, 1947, 1948.

STARS.

1898. Spectrophotometric Criteria of Stellar Luminosity. B. Lindblad and E. Stenquist. *Astron. Iakttagelser och Undersökning, Stockholms Obs.* 11. 12. [75 *pp.*], 1934. *In English.*—For early type stars, B to F8, the intensity of Hγ and Hδ is measured against the mean of the two adjacent regions on either side of the line. For late type stars, F8 to M, the change of intensity at the band G and the difference of intensity c between the densest part of the cyanogen band around 4180 and a standard region at 4260 are used. In both cases the colour equivalent k is the gradient of the best straight line through five points between 4400 and 4050. The instrumental arrangements, and reductions, including tests of the effect of the density of the spectral image, and certain refinements of spectrum classification, are given in detail. For early type stars, the Pleiades group are used and extensive comparisons made with previous work. For late stars, the cyanogen equivalent c is shown to effect almost complete separation of giants and dwarfs for each spectrum type, and with a spectrum correction is a well defined function of absolute magnitude. The spectrum correction can even be avoided by using G and k. The reverse problem of the most probable absolute magnitude for given c is discussed. A discussion of the physical significance of this criterion is also given. Catalogues of all stars considered form an appendix. T. L. M.

1899. Luminosities of Be Stars. N. W. McLeod. *Harvard Coll. Obs., Bull. No.* 894, *pp.* 1–5, *Feb.* 1, 1934.—Since Gerasimovič in 1927 confined his investigation to Class B3e, the author reinvestigates, dividing the stars into three groups, Oe–B2e, B3e, and B4e–B9e. A table is given of solar motions and absolute magnitudes for the three groups; the adopted mean absolute magnitude (— 1·3), for the B3e stars is in marked disagreement with Gerasmovič's (— 3·6). The luminosities of Be stars are also studied in the Large Magellanic Cloud, in the Double Cluster in Perseus, and in the Pleiades. A table gives the mean absolute magnitudes (in brackets) of Classes Beq (— 5·6), cBe (— 5·1), BOe (— 3·0), B1e (— 2·5), B2e (— 2·0), B3e (— 1·4), B5e (— 1·4), B8e (— 1·0). The companion of Mira is a Be white dwarf of absolute magnitude + 6; S Doradus is about 500,000 times as luminous as *o* Ceti; the Be stars have as great dispersion in luminosity as any other class of spectra, and on the average are not more than 0·4 magnitude brighter than normal B stars. A. S. D. M.

1900. Colorimetric Examination of Stars up to the Fifth Magnitude between the North Pole and 40° South Declination. K. Graff. *Akad. Wiss. Wien, Ber.* 142. 2*a* .8. *pp.* 387–419, 1933.—The colours of the stars up to magnitude 5^m10 and declination — 40° are measured with a blue-red wedge colorimeter [see Abstract 774 (1932)]. The results of these measurements are given in catalogue form along with other data such as the usual symbol of each star, the number of the revised Harvard photometry, the approximate positions in 1900, the visual magnitude, the galactic coordinates and the spectrum according to the Draper catalogue. The colour catalogue contains data for 1116 stars. [See following Abstract.] J. E. K.

1901. Regularities in the Colour Variations of Stars on the Horizon. K. Graff. *Akad. Wiss. Wien, Ber.* 142. 2*a*. 9–10. *pp.* 529–530, 1933.—From the measured atmospheric colour excesses ΔF, listed by the author [see preceding Abstract] the following formula is derived:— $\Delta F = 0{\cdot}278\ (s - 3{\cdot}53)$ where s is the length of path traversed by the light of the star in the earth's atmosphere. This may be otherwise expressed as $\Delta F = -\ 0{\cdot}70 + 2{\cdot}02e$ where e is the atmospheric extinction factor. J. E. K.

1902. Colorimetric and Photometric Observations of δ Cephei and η Aquilæ. K. Graff. *Akad, Wiss. Wien, Ber.* 142. 2*a*. 9–10. *pp.* 523–528, 1933.—The periodic variations of colour of δ Cephei and η Aquilæ are measured with a visual wedge colorimeter. At the same place and practically the same time photometric observations of the brightness are also made. The phase of the brightness curve of δ Cephei lags behind that of the colour curve by 0·3 day; there is no phase difference between these curves in the case of η Aquilæ. The colorimetric data are compared with previous spectroscopic measurements of light variations. J. E. K.

1903. Variable Spectrum of VV Cephei. D. B. McLaughlin. *Astrophys. J.* 79. *pp.* 380–394, *May,* 1934.—The absorption spectrum of VV Cephei is gM2, upon which is superimposed hydrogen emission lines subject to great changes in their relative component intensities, so that the ratio of emission of violet to red at Hγ and Hδ, varies; H and K taking a synchronous part. The mean velocity of the M spectrum is − 33·9 km./sec. for epoch 1933–4 and double maxima and minima of velocity are indicated in a light curve cycle. VV Cephei differs from a typical Be star in that the red component is conspicuously the stronger; this may be a permanent characteristic. Except for one sudden change, the hydrogen emission was stationary during interval of observation. The H and K of Ca II show a pronounced negative shift with respect to the hydrogen lines. Ca II absorption seems to originate high enough in the stellar atmosphere for it to be relatively free from superimposed Hε emission. The position of the ion lines is not definite, but may be due to an enmeshing nebula. VV Cephei is a 20-year period binary, and possibly the secondary star accounts for hydrogen emission and absorption, and the Ca II lines. The author suggests that all long-period variables owe the excitation of their strong hydrogen emission line to a faint high temperature companion, the M spectrum primary giving the light variations; he cites *o* Ceti and R Aquarii.
A. S. D. M.

1904. Colour Indices of 535 Faint Stars of Known Spectra in Low Galactic Latitudes. Emma T. R. Williams. *Astrophys. J.* 79. *pp.* 395–408, *May,* 1934.—The mean colours of 535 tenth- and eleventh-magnitude stars in and near the Milky Way are studied. It is found that close to the galactic plane, tenth-magnitude A stars are 0·3 more reddened than tenth-magnitude G stars, and this differential reddening increases with increasing magnitude and decreases with increasing distance from the Milky Way. It is found that the usually quoted values of about 0·3 per 1000 parsecs for the visual and differential absorption coefficients are not consistent with these data, a photographic absorption coefficient greater than 1 mag. per 1000 parsecs in the galactic plane being indicated for regions within about 700 parsecs of the sun. AUTHOR.

1905. Intensities of Stellar Absorption Lines. O. Struve and C. T. Elvey. *Astrophys. J.* 79. *pp.* 409–440, *May,* 1934.—The intensities of stellar absorption lines have been measured in the spectra of α Canis Majoris, α Lyræ, α Cygni, α Persei, ε Aurigæ and 17 Leporis. With the help of theoretical multiplet intensities, curves have been constructed, for each star separately, showing the relation between total absorption and number of atoms. These curves differ considerably. All parts of the curves lie between the limits A =Const. and $A \propto N$. An application of the theory of Schütz based upon the simultaneous effects of radiation damping and thermal Doppler broadening shows agreement with the observations in α Canis Majoris, α Lyræ, and α Cygni, provided, however, the damping constant is assumed to be ten times that given by the classical theory. For the remaining three stars the hypothesis is advanced that in their atmospheres turbulent motions far exceed the motions caused by thermal agitation. The theory of Schütz is enlarged to include the case of turbulent motions, and excellent agreement with the observations is found. The most probable turbulent velocity is found to be 67 km./sec. in 17 Leporis, 20 km./sec. in ϵ Aurigæ, and 7 km./sec. in α Persei. The interpretation of many other observational data in the light of the turbulence hypothesis is briefly discussed. AUTHORS.

1906. Physical State of Matter in the Interior of Stars. S. Chandrasekhar. *Observatory*, 57. *pp.* 93–99, *March*, 1934.—The author considers the three possible equations of state of a more or less completely ionised gas, corresponding to the perfect, degenerate, and relativistically degenerate gas respectively. He treats stars of great, small and medium mass, and white dwarfs, separately. He concludes that for the above equations and for a star not a white dwarf, it is possible to have finite physical conditions at the centre only if the star is wholly a perfect gas configuration. He points out, however, the uncertainty introduced by possible transmutations and deviations from the ideal gas law at present unknown. T. L. M.

1907. First Search for a Metagalactic Gradient. H. Shapley. *Harvard Coll. Obs., Bull. No.* 894. *pp.* 5–13, *Feb.* 1, 1934.—A search is made for evidence of a centre or an edge of the metagalactic system; that is, of increasingly greater density of matter in some one general direction, by examining the distribution and luminosity curves of galaxies in 24 fields each of 9 square degrees. These regions are all on the polar side of ± 40° galactic latitude, so as to exclude any question of our galactic absorbing material. The bright galaxy survey of the 12th and 13th magnitudes of the north and south hemispheres give $N_n = 1 \cdot 6\ N_s$ and the 18th magnitude survey also gives the north more numerous than the south, and for the polar caps between the 14th and 18th magnitudes, $N_n = 1 \cdot 4\ N_s$. The new survey shows that there is large variation from one region to another. Near the 18th magnitude, it is seen that the ratio approaches equality, and the Mt. Wilson results at the 20th magnitude show equality as attained. A. S. D. M.

1908. Abnormal Variable Star in Cluster Messier 3. P. Guthnick. *Preuss. Akad. Wiss. Berlin, Ber.* 24. *pp.* 724–745, 1933.—The star, Bailey 95, unusually bright, very red, at first suspected Algol variable, was classified as irregular. The author has studied it on 145 plates: in 1924–5 it was only once found unusually faint. In 1932 it was found about 0·3 mag. below normal. In 1933 a complete minimum was observed. It appears to be an eclipsing variable of long period, where the total eclipse of the smaller but brighter and less red component gives a constant phase of 25 days. It is probably similar to ζ Aurigæ. The period cannot yet be determined. A detailed examination of the accuracy of measurements of focal plates of star clusters is given. T. L. M.

1909. Statistics and Hypothetical Elements of Long-Period Double Stars. D. Barbier. *Bull. Astronomique*, 8. 3. *pp.* 131–168, *and* 8. 4. *pp.* 169–212, 1933.—The number of well determined double star orbits is small and subject to several types of selection, which are discussed in detail. In order to reduce selection, and to obtain sufficient data for statistical discussion, the author considers several methods of obtaining hypothetical values of the elements. For cases in which the rate of change of position angle and radius vector can be observed, the distribution of the eccentricities and mean anomalies can be determined. Hypothetical values of these elements are derived for 183 pairs. There is still selection of mean anomalies. The average eccentricity is 0·66. Hypothetical periods are derived; their geometric mean is of the order of 500 years. The latter are correlated with the eccentricity; and possibly with spectrum type; but there is no clear correlation of type and eccentricity. The orbital planes have a tendency to lie parallel to a great circle whose pole is near the centre of the galaxy. The possibility of increasing the number of pairs to which such methods can be applied is discussed. Where a good parallax is known, the second derivative of the radius vector is not required, and couples with longer period can be considered. But the use of dynamical parallaxes is subject to certain restrictions. The methods employed are subjected to exhaustive mathematical analysis. The data and hypothetical elements of all pairs considered are tabulated. T. L. M.

1910. Light Curves of Cepheid Variables. L. V. Robinson. *Harvard Coll. Obs., Ann.* 90. 2. *pp.* 27–92, 1933.—A photographic survey of 106 Cepheid variables. Hertzsprung's theory that there is a close correlation between period and light curve is discussed; this does not hold for cluster variables with periods less than a day, or for classical δ Cepheids of from 1 to 8·5 days period, but the clusters show a secondary oscillation immediately preceding minimum light, and sometimes a secondary wave in the descending branch, and (in many cases) a flat minimum. In the classical 1–8·5 days, this is very slight, but they do show the descending branch secondary wave, and the 8·5–30 days Cepheids show a relation between period and light-curve except in the cases of SZ Cassiopeiæ, Y Ophiuchi and RU Camelopardalis; but in these three stars with SV Monocerotis and CD Cygni there is a secondary wave in the ascending branch which Hertzsprung identifies with the primary maximum in the Cepheids of less than 8·5 days. The relations of Range to period, to frequency of period, to steepness of light-curve, and to range in radial velocity are discussed; also of mean range to median range; and the light-curves of galactic and extra-galactic Cepheids. A. S. D. M.

1911. Computation of Orbits of Visual Binary Stars. L. Picart. *Comptes Rendus,* 198. *pp.* 867–870, *March* 5, 1934.—The method depends on replacing the calculation of the equation of the apparent ellipse by that of the derivatives of the coordinates. The formulæ for computation are given in full. The advantage claimed is that the preliminary calculations can be verified; the method is thus suitable when the observed arc is short. T. L. M.

1912. Photoelectric Study of W Ursæ Majoris. C. M. Huffer. *Astrophys. J.* 79. *pp.* 369–379, *May,* 1934.—The variable star W Ursæ Majoris has been observed with the photoelectric amplifier on the 15-inch telescope of the Washburn Observatory. The measures of this eighth-magnitude star are of satisfactory precision, the probable error of a single normal magnitude being ±0·011. A new formula representing the photographic and photoelectric minima has been derived, and it is shown that the period of revolution of this system is definitely shortening at the present time. The solution for the elements is partly indeterminate, but the variation of light may be explained by the mutual eclipses of two ellipsoidal bodies slightly unequal in size, mass, and brightness, and both darkened at the limb. A combination of spectrographic and photometric results shows that both bodies are smaller than the sun, with densities 2·0 and 3·3 on the solar standard. AUTHOR.

1913. Twinkling of Stars and Associated Problems. R. Pozdèna. *Gerlands Beitr. z. Geophys.* 41. 2. *pp.* 203–208, 1934.—A number of novel points of view are presented and discussed relating to the connection between the colour, brightness and positional flickering of stars on the one hand and meteorological conditions and general movements of air in the earth's atmosphere on the other. J. E. K.

See also Abstracts 1918, 2051, 2063, 2230.

SUN.

1914. Extent of the Chromosphere. R. M. Petrie. *Astrophys. J.* 79. *pp.* 365–367, *April*, 1934.—The height of the chromosphere in $H\alpha$, $H\beta$, and D3 is determined from spectra taken with a radial slit. The results are in agreement with visual observations in giving values about one-half of those derived from flash spectra. AUTHOR.

1915. Intensity of Sun's Ultra-Violet Rays (λ 3200). W. E. Bernheimer. *Akad. Wiss. Wien., Ber.* 142. 2a. 9–10. *pp.* 449–456, 1933.—From a series of thermoelectric measurements of the ratio of the intensities of the sun's rays in the ultra-violet (λ 3200) and the green (λ 5000), made in America from April, 1925, to June, 1933, tables and graphs are drawn up to show the mean variation from month to month, assuming that the intensity in the green is unchanged. There is found to be no correlation between the ultra-violet intensity and solar constant, nor have sunspots or the ozone content of the atmosphere any marked effect. Thus it appears that the American results, especially in the ultra-violet are not really due to a change in the energy of the sun's rays themselves. H. M. B.

1916. Total Radiation Measured by a Bellani Lucimeter. L. Besson. *Comptes Rendus*, 198. *pp.* 1130–1132, *March* 19, 1934.—The records of a Bellani lucimeter when compared with those of a solarimeter with thermoelectric cell at the Tour St. Jaques (Paris) show good agreement during March to October, the maximum deviation being 4 %, and on 66 % of days $\not>$ 2 %; but during November to February it is on 50 % of the days $>$ 3 %, with a maximum deviation of 14 %, the lucimeter being less sensitive to diffused light, though its collector being spherical instead of horizontal no correction for the elevation of the sun is necessary. Eleven years (1923–33) monthly averages (Jan.–Dec.) of radiation at the Tour have been 54, 108, 199, 290, 374, 414, 399, 359, 261, 148, 67 and 41 cal./cm.^{2}/min. C. A. S.

1917. Nature of the Photosphere and Solar Electronic Emission. A. Dauvillier. *Comptes Rendus*, 198. *pp.* 902–904, *March* 5, 1934.—The author regards the rice-grains of the photosphere as analogous to kathode spots, such as produced in a mercury vapour lamp by cooling the wall near the kathode. The sun's radiation would thus be only indirectly of thermal origin. The lower limit to the electronic emission at the distance of the earth is obtained; the effect of the earth's magnetic field is outlined. T. L. M.

1918. Relations Connected with Positions of Solar Apex. F. K. Edmondson. *Astron. J. No.* 1004. *pp.* 92–95, *Feb.* 28, 1934.—The author derives correlations between the coordinates of the solar apex and the parallax of the stars used in his determinations [see Abstract 2878 (1933)]. He introduces additional stars, considers the distribution in galactic coordinates and with new axes based on the line of drift found (corresponding to Mineur's second drift), and discusses correlations with the velocity. He concludes that the axis of drift of positions of the apex is perpendicular to the direction of the centre of the local cluster; a rotation of this cluster is thus again suggested. The deviations from this axis agree with Strömberg's asymmetrical drift. This drift also produces the linear relation between velocity towards the standard apex and apparent magnitude of stars used; this relation is found to hold only for the brighter stars, contrary to Seares' finding. The results should affect determinations of mean parallax of stars from secular parallax. T. L. M.

1919. Calibration of Rowland's Scale of Intensities for Solar Lines in Equivalent Breadth. G. F. W. Mulders. *Zeits. f. Astrophysik*, 8. *pp.* 62–65, *Feb.* 14, 1934. *In English.*—The intensities of absorption lines in the solar spectrum have been measured at Utrecht in order to obtain a quantitative calibration of Rowland's arbitrary scale, extending over all wave-lengths. The investigation is now nearly completed, and a concise summary of the principal results can be given. As shown in a figure, the "equivalent breadth" of a line which corresponds with a certain Rowland intensity does not remain constant for different wave-lengths. Its value increases from the ultra-violet to λ 5500, then decreases markedly to λ 5900, then steadily increases again onwards to the red and infra-red. M. A. E.

1920. Atmospheric Water-Vapour Band 6324Å in the Solar Spectrum. V. Kondratjev and D. Eropkin. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 1. 4. *pp.* 170–175, 1934. *In German.*—With a 7 m. spectrograph photographs are taken of the spectrum of the sun 1° above the horizon. In a region of 170Å around 6300Å 235 new lines are discovered and 67 of these lines are identified. Forty-two of the 67 lines are definitely telluric lines and, of these 42, 27 belong to the H_2O band at 6324 Å. It is not certain whether the remaining 25 identified lines are telluric or not, probably not. Some of the lines classified as metallic lines in Rowland's Tables are thought to be telluric lines. As a result of the extended analysis of the band 6324 Å the most important constants for the H_2O molecule in the (3,1,1) state are calculated. J. E. K.

GEOPHYSICS.

GEODESY.

1921. Physical Geodesy. F. Hopfner. *Gerlands Beitr. z. Geophys.* 41. 2. *pp.* 181–184, 1934.—The author criticises the use made by Jeffreys of the free-air formula for the reduction of observed gravity values to sea level since the formula gives no boundary values for the geoid and also transforms the observed values. He proves that the free-air formula is invariable for the reduction of observed values of gravity to sea level. For the transformation of observed values of gravity at the boundary of the geoid the only practicable method is with the help of Prey's reduction formula. He also disagrees with Jeffreys' criticism of the derivation of the equation of surface potential. [See Abstract 4809 (1933).] R. S. R.

1922. New Geoids. R. Schwinner. *Gerlands Beitr. z. Geophys.* 41. 2. *pp.* 213–224, 1934.—In Ackerl's geoid elevations over the spheroid are +, and depressions — : Hirvonen's is the reverse. Ackerl reduces in conformity with Prey's method, and does not compensate : Hirvonen uses the free-air method and assumes isostasy. Both methods lead to the result that a spheroid with 3 axes does not fit the figure of the earth. But the earth's surface differs only unessentially from that of a rotation spheroid, and is isostatically compensated. Hirvonen's hypothesis conforms the more closely to the requirements of the geologist. W. A. R.

1923. Cross-Sections with Hand Clinometers. H. Löschner. *Zeits. f. Instrumentenk.* 54. *pp.* 108–117, *April*, 1934.—Illustrations of the use of hand instruments are given, and compared with results from more elaborate apparatus. It is concluded that the hand instruments give results sufficiently accurate for the constructional engineer. W. A. R.

See also Abstract 1856.

GEOPHYSICS, APPLIED.

1924. Resistivity Electrical Prospecting. A. Belluigi. *Beitr. z. Angew. Geophys.* 4. 2. *pp.* 126–133, 1934. *In Italian.*—Referring to Hummel's studies on the solution of the three and four layer problem of electrical prospecting by the resistivity method, the author indicates the practical importance of the theory for the case of many layers. By the employment of an assumption that Kirchhoff's law of the mean resistivity of parallel conductors holds valid, tables and diagrams are derived for different values of the resistivity ratios and depth of layer ratios. E. L. J.

1925. Instrument for Inductive Electrical Prospecting. J. McG. Bruckshaw. *Phys. Soc., Proc.* 46. *pp.* 350–364, *May* 1, 1934.—This paper deals with an examination of the conditions in the Bieler-Watson method of geophysical surveying, and demonstrates that, in general, the horizontal field is not in quadrature with the vertical field. An instrument has been designed which will allow the horizontal field to be compared completely with the vertical field, the important feature of the instrument being that the horizontal components in phase and in quadrature with the vertical field are obtained directly from the instrument readings. The apparatus has been tested on elliptically polarised fields and has given satisfactory results. AUTHOR.

1926. Vertical Gradient of Gravity. S. Reisch. *Beitr. z. angew. Geophys.* 4. 2. *pp.* 134–151, 1934.—Although many previous efforts have been made to measure the variation in the force of gravity in the vertical direction, as distinct from its variation in the horizontal direction measured by the Eötvös torsion balance, mechanical difficulties have hitherto prevented the practical realisation of these attempts. The author discusses a project for increasing the sensitivity of the Jolly balance to the desired extent without fundamentally modifying its construction. The project involves the application of a photoelectric compensating device for measuring very small displacements with extreme precision, of the type recently developed by various investigators. The sensitivity of reading aimed at involves measuring a variation of 0·0001 mm. in a range of 1 mm., which is within the capacity of the compensating photoelectric measuring device described. Measurements to the desired degree of precision may be completely vitiated by disturbing effects, such as those due to elastic after-effects in the beam arm, and temperature fluctuations in the balance chamber. The precautions necessary to guard against these disturbances are considered. It remains to be determined whether the project is realisable in practice. E. L. J.

1927. Obscure Cases in Refraction Seismic Prospecting. G. Brinckmeier. *Beitr. z. angew. Geophys.* 4. 2. *pp.* 152–164, 1934.—The determination of the depth of a geological layer by seismic refraction prospecting methods is involved in special difficulty in certain cases where successive layers have propagation velocities for seismic waves which increase from layer to layer from the surface downwards. In such cases the existence of the layers next to the top may be completely masked by the undermost layer, the observed phenomena presenting the appearance of a two-layer problem, although the intermediary layer or layers vitiate by their presence the depth estimation of the lowest layer. The special cases of inclined interfaces, including cases where the intermediary layer is lens-shaped, are discussed theoretically. E. L. J.

HYDROSPHERE, PHYSICS OF THE.

1928. Conduction of Heat in the Sea. J. E. Fjeldstad. *Geofysiske Publ.* 10. 7. [20 *pp.*], 1933. *In German.*—The temperature of the surface layer of the sea depends on heating caused by solar and diffuse sky radiation and to a smaller extent by warmer air, cooling caused by radiation, evaporation and convection and thus on the cloudiness, vapour pressure, and wind while mixing by wave motion extends these changes to a depth of 10–20 m. Molecular conduction of heat plays only a small part. A formula is derived by which the vertical change of heat conductivity can be calculated. Horizontal heat transport between currents at different depths plays a part and Helland-Hansen found for the N. Atlantic a definite relation between salt content and temperature. At the surface this relation has an annual variation but a definite normal value. By deviations from the normal curve Helland-Hansen obtained the deviations from mean temperature, and thus the approximate annual oscillation can be obtained. The author considers these temperature curves for the Bay of Biscay and finds a whole temperature oscillation of 7·8° C. which is in very good agreement with results obtained by statistical treatment of surface temperatures. The heat conductivity (η) depends greatly on turbulence, has a big annual variation, and changes greatly with depth, but does not exceed 20 (c.g.s.) at the surface. No annual oscillation is found at a depth exceeding 500 to 600 m. and η seldom exceeds 40 (c.g.s.).

R. S. R.

1929. Internal Waves. J. E. Fjeldstad. *Geofysiske Publ.* 10. 6. [35 *pp*.], 1933. *In German.*—The author refers to phenomena observed by Nansen, Helland-Hansen and Petterson regarding oscillations at places of isohalines and isotherms which appeared to follow a tidal period and are due to internal waves, and to the theoretical treatment from many sides of the problems. The author deals with the general case where any density distribution with depth occurs. In a theoretical treatment he examines the cases of (1) waves without rotation of the earth, these being remarkable only in the middle layers, and the velocity distribution in this layer can be very complicated if many of these waves occur simultaneously; and (2) internal waves in a rotating sea. Calculations of the internal waves are illustrated, and the numerical integration method is applied to determine the rates of propagation for the cases of (1) the Faeroes-Shetlands Channel for depths ranging from 580 m. to the surface, and (2) the Michael Sars station at 30° 20′ N and 50° 50′ W with a depth of 5400 m. The method involves the harmonic analysis of the observed direction and velocity of flow, and its resolution into two circular components, and the direction of propagation and amplitude of the waves are found. Oceanographic investigations show that internal waves are the rule, and not the exception, and the change of velocity with depth can be very complicated. Also many waves with different rates of propagation may occur, but owing to difficulties in interpreting the results they are to be dealt with later.

R. S. R.

1930. Poincaré Waves of the Second Type. E. Fichot. *Comptes Rendus*, 198. *pp*. 1091–1094, *March*, 1934.—The structure and interference of waves of the first type were considered earlier by the author [see Abstract 450 (1930)] and also theoretically by Taylor, Proudman and Fjeldstad but a special type of movement with c and γ imaginary which occurs when $\mu^2 < 4\omega^2 + \frac{m^2\pi^2gh}{b^2}$ has not previously been considered. This occurs for a sea wave of relatively long period affecting a straight deep canal with raised banks sufficiently distant from the pole. The equations for Poincaré waves of the second type with real form are established, and the form and amptitude of the waves at different points are discussed. It is shown that the solution briefly indicated by Poincaré embraces two types of oscillations essentially distinct in each of which it is necessary to have interference of two opposed waves in order that the phase of the resultant motion depends at the time on x and y. The coexistence of two Poincaré waves of the same frequency but different types is rigorously possible under the condition that the waves are not of the same size.

R. S. R.

1931. Automatic Mareograph. E. Levin. *Journ. Sci. Instruments*, 11. *pp*. 118–120, *April*, 1934.—The photo-mareograph is designed to avoid the errors characteristic of the usual type of self-registering tide gauge. The part of the tide-staff at sea-level is automatically photographed at regular intervals. The figures on the film correspond to the position of the float when the exposure is made. Details of construction and of the method of illuminating the staff are given. AUTHOR.

1932. Motion in Irregular Lakes. H. Ertel. *Preuss. Akad. Wiss. Berlin, Ber.* 24. *pp*. 746–750, 1933.—The author outlines the methods proposed for dealing with the internal tidal motions in bounded water-masses. The new method is based on the application of wave mechanics to disturbed motion of fluids. It is limited to cases where the shape is such that the transverse motion can be neglected in the first instance in comparison with the longitudinal motion. It is shown that the so-called Japanese method of Honda and others is a special case of this solution.

T. L. M.

1933. Damping of Seiches in Lakes. A. Endrös. *Gerlands Beitr. z. Geophys.* 41. 2. *pp.* 130–148, 1934.—Damping depends not so much on bottom friction in the basin, but more on internal friction. It is greatly increased in irregular lakes, especially in those with the node at a shallow or contracted place in the lake. Even when the lake has a regular configuration any irregularity near the node, such as a projection, has a strong damping effect. A further cause of strong damping is the mutual interference of fundamental oscillations, occurring simultaneously.

W. A. R.

1934. Transport of Silt by a Stream. E. G. Richardson. *Phil. Mag.* 17. *pp.* 769–783, *April,* 1934.—After enumerating the factors upon which the erosion and subsequent transport of the bed of a stream may be expected to depend, details are given of the experimental methods used. Curves illustrate the relations obtained between the height above the bed of the stream and (1) the velocity of flow, and (2) the density distribution of sand and Fuller's earth. The theory connecting the force per unit area on the bed and the total amount of silt transported in unit time is given. From the investigations it was found that the transport of silt is mainly due to turbulence in the stream, under which conditions the vertical distribution is nearly exponential and the lifting force is proportional to the square of the velocity. Below the critical speed the silt is moved to a much less extent, and the movement is confined to the smaller particles in the lower strata of the stream. R. S. R.

LAND, PHYSICS OF THE

See Abstracts 1784, 1834.

METEOROLOGY.

1935. Atmospheric Ozone Measurements. C. L. Pekeris. *Gerlands Beitr. z. Geophys.* 41. 2. *pp.* 192–202, 1934. *In English.*—This paper deals with the problem of the determination of the ozone distribution in the atmosphere from measurements by the direct method. The conditions for the existence of a unique solution of the integral equation $N(v) = 1/2\int_{R^2}^{\infty}\left(\rho(u)/\sqrt{u-v}\right).du$, are discussed in the light of the work of Picard. A method is developed for the numerical solution of this equation. This is followed by an alternative method suggested to the author by G. D. Birkhoff. It is found that the present day accuracy of the part of the measurements which is most relevant in determining the distribution of ozone is quite insufficient. In the last part of the paper, the possibility of applying the direct method to atmospheric soundings by solar radiation is discussed. AUTHOR.

1936. Distribution of Ozone in the Atmosphere. D. Barbier. *Comptes Rendus,* 198. *pp.* 1060–1062, *March* 12, 1934.—Using Fabry and Buisson's method the values for the total amount of ozone encountered, $N(\phi)$, by a luminous ray coming from the sun at a zenithal distance, ϕ, can be obtained from $N(\phi) = \int_R^\infty (r \cdot \rho(r) / \sqrt{r^2 - R^2\sin^2\phi}) \cdot dr \ldots (1)$, where R is the earth's radius, r the distance of any point on the ray from the earth's centre and $\rho(r)$ the amount of ozone at each point of the atmosphere. The views of Mineur and Chalonge on the solution of this equation are stated. It is known that an approximate solution is given by $N(\phi) = \epsilon D / \sqrt{D^2 - R^2\sin^2\phi} \ldots (2)$, where ϵ is the total amount of ozone concentrated in a thin layer at a distance, D, from the earth's centre. A continuous function of $\rho(r)$ can be obtained to give the least error desired and in agreement with the errors of observation by using $\rho(r) = (1/\sigma\sqrt{2\pi}) \cdot e^{-(r-D)^2/2\sigma^2}$ and when σ tends to zero equations (1) and (2) approach equality. The application of this method to observations and the relations found between the symmetry of the ozone distribution and the mean height of the layer are discussed. R. S. R.

1937. Absorption of Heat Rays by Fog. E. O. Hulburt. *Physics*, 5. *pp.* 101–102, *April*, 1934.—Measurements between two stations 0·4 km. apart of the intensity of heat rays transmitted through fog showed that, although 7μ rays were slightly less absorbed by fog than visible light, their penetration into fog was too slight to be of practical interest. For a fog of visibility 0·6 km. the distances to reduce the light to 10^{-2} were 910, 970, 980 and 1140 m. for wave-lengths 0·6, 1, 3 and 7μ, respectively. AUTHOR.

1938. Brunt's Formula for Nocturnal Radiation of the Atmosphere. C. L. Pekeris. *Astrophys. J.* 79. *pp.* 441–447, *May*, 1934.—It is shown that the linear dependence of the downgoing radiation of the atmosphere on the square root of the surface vapour pressure, discovered empirically by Brunt, can be explained by Dennison's theory of the shape of infra-red absorption lines. The theory is substantiated by Fowle's measurements of the total absorption in the bands 0·8μ, ρ, and Φ of water vapour. AUTHOR.

1939. Parallelism of Stream Lines and Isohypes in an Adiabatic Layered Atmosphere with Steady Flow. H. Ertel. *Preuss. Akad. Wiss. Berlin, Ber.* 24. *pp.* 751–753, 1933.—Defant states [see Abstract 4826 (1933)] that in an adiabatic atmosphere a steady air flow can be set up only in one way over an uneven surface in that it follows the isohypes of the surface elevations. It is shown that a corresponding analogy has been known in oceanography for a long time. A proof is given in the paper that this statement can be extended and generalised in the form that if over an uneven surface the atmosphere is so built up that up to a height $z = H$, a homotropic relation exists, then at each level $z \leqq H$ there must be a steady flow free from acceleration coinciding with the isohypes of surface topography. H is a geometrical function of the form $H(\psi, \Phi) = 0$ between two characteristic variables of state, pressure (ψ), and mass (Φ), for which the pressure, p, and one of the three parameters ρ (density), α (specific volume), and T (temperature) can be chosen since between the last three the equations $p = RT\rho$ and $\rho\alpha = 1$ exist. The proof has advantages over that given by Defant. R. S. R.

1940. Halo of Unusual Radius. R. G. Stone. S. Pagliuca and W. J. Humphreys. *Monthly Weather Rev.* 61. *pp.* 327–329, *Nov.*, 1933.—A circular lunar halo observed by the first two authors on 4th October, 1933, at Mount Washington Observatory, is described. The radius, as measured was 23·5° from the inner edge to the proximal limb of the nearly full moon, being markedly greater than the normal 22° radius. The sky was covered with cirrostratus. Another halo observed the same evening, at Blue Hill Observatory, gave as the radius from the edge of the moon to the inner edge of the halo 18·2°. No other halo was observed and the sky was covered with cirrostratus. W. J. Humphreys discusses these observations and shows that the explanation may be found in the rather rare truncated pyramidal type of ice crystal where the slope of the pyramid face to the longitudinal axis is very close to 24°51′. This type is discussed in his *Physics of the Air*, p. 517 (2nd edition). The reason for the abundance of this rare type of crystal on that particular occasion is not apparent. A. E. M. G.

1941. Auroral Spectrum. L. Vegard. *Geofysiske Publ.* 10. 4. [61 *pp.*] 1933. *In English.*—The programme of spectroscopic observations of the aurora to be carried out at the Auroral Observatory, Tromsø, is discussed in detail. The various instruments employed and built for this work are described at length. The observations and results of the first three winter seasons are given in full, including observations on the infrared auroral spectrum. The results are discussed and correlated with laboratory observations—especially observations of the luminescence of solidified gases. Apart from the strong green (λ5577) and red (λλ6303 and 6368) auroral lines all the stronger bands observed are ascribed to nitrogen, and a number of weaker bands and lines may also be due to this element. The spectral variation with auroral colour is also considered. A. H.

1942. Auroral Spectrum. L. Vegard and L. Harang. *Geofysiske Publ.* 10. 5. [13 *pp.*] 1933. *In English.*—A number of low dispersion spectrograms have been obtained of the auroral spectrum in the infra-red, extending as far as λ8150. The whole of the observed spectrum can be accounted for as forming part of the 1st positive group of nitrogen. An attempt is made to determine the relative intensities of the two red lines (λλ6302 and 6367), which leads to the value $I_{6302}/I_{6367} = 1 \cdot 65$. A. H.

1943. Influence of Air Flow on the Results of the Psychrometer. H. Ebert and A. Pfeiffer. *Zeits. f. Instrumentenk.* 54. *pp.* 92–94, *March*, 1934.—The paper forms a reply to criticisms by Bongard of views and equations given in an earlier paper by the authors. The criticisms considered and the conclusions drawn are: (1) the experiment of Svenson is not in opposition to the authors' views on the influence of radiation and conduction on the form of the psychrometric formula; (2) it was incorrect to state that no consideration was given to the part of the free energy in the vaporised liquid which does not remain bound to the air mass forming the diffusion and temperature field of the vaporised air; and (3) the application of the thermodynamic model to the process of the psychrometer was correct, since the conditions of rapid or slow air-flow past the thermometer bulb were set out. Bongard's model is applicable to those psychrometers whose limits of cooling are given by the Sprung formula, which involves a good air flow. R. S. R.

SEISMOLOGY.

1944. P′P′ and Related Waves. B. Gutenberg and C. F. Richter. *Gerlands Beitr. z. Geophys.* 41. 2. *pp.* 149–159, 1934. *In English.*—Certain phases appearing on the records of Benioff vertical seismographs in S. Californian stations 30–45 min. after a shock, and at first attributed to aftershocks, are shown to be due to waves that have twice (or thrice) passed through the central nucleus of the earth and once (or twice) been reflected from the under surface of the earth, *i.e.* *PcPcPPcPcP* (or *P′P′*), or *PcPcPPcPcPPcPcP*, or similar waves with one or more portions transversal instead of longitudinal, *e.g.* $ScPcPPcPcP$. All such have focal points accounting for the magnitude of the recorded phases. Their travel times depend almost entirely on the epicentral distance, being nearly independent of the focal depth. They are therefore of value in determining the epicentral distance of deep focus earthquakes, and for this purpose travel times have been plotted for $P'P'$, $ScPcPP'$ (?), and $P'P'P'$, and also curves showing $P'P' - P$ and $P'P'P' - P$ [see Abstract 1396 (1933)]. C. A. S.

1945. Deep-Focus Earthquakes. B. Gutenberg and C. F. Richter. *Gerlands Beitr. z. Geophys.* 41. 2. *pp.* 160–169, 1934. *In English.*—As an example of the method foreshadowed [see preceding Abstract] the focal depth (about 350 km.) of a deep-focus earthquake recorded in California is worked out in detail (*a*) from the travel time differences $pP - P$ and $sP - P$ with the aid of Scrase's [see Abstract 3746 (1931)] and Jeffreys' tables (the latter with the 6 sec. correction), and (*b*) from the tables showing $P'P' - P$ and $P'P' - O$. The two results agree satisfactorily. They may be further checked by using $P'P'P'$ or $ScPcPP'$. C. A. S.

1946. Development of the Wave Conception. Part VII. K. Uller. *Gerlands Beitr. z. Geophys.* 41. 2. *pp.* 225–249, 1934.—The general investigation of the wave conception [see Abstract 4118 (1931)] is continued and the general wave form and principles of interference are specially considered. It is shown that ordinarily two phases and two kinds of source are produced, the intensity of the wave not being a pure space function and the phase surfaces not at rest. The phase surfaces are generally dependent on the time and consequently also the kinematic wave limiting conditions and the Doppler effect. Expressions are obtained for the general wave form with two phases, and for the interference principle with linear homogeneous field equations. Finally the system of equations is obtained for a number of wave forms of a wave family in relation to the field equations for fluids, heat, elasticity and electromagnetism. This coordinates the two fields in the Maxwell basic equations, while not permitting the former arbitrary subdivision into pure shearing and compressional waves. This can be used in dealing with the greater period found for the same earth wave the further the observatory is from the focus, but it will require records of favourable earthquakes which produce a constant period of pure sine form and there must be observations for one and the same wave of the succession of periods in different observatories. R. S. R.

1947. Influence of the Moon on the Frequency of Earthquakes. L. Rodés. *Gerlands Beitr. z. Geophys.* 41. 2. *pp.* 209–212, 1934. *In English.*—In a former paper on the frequency of earthquakes the diurnal period found for the observations at Ebro gave a maximum at 21 hr. and a minimum at 08 hr., the maximum occurring when the region Andes to the Aleutian Islands, passed in front of the sun. The effect was shown to be a thermal and not a tidal phenomenon. For the lunar effect, the tidal action should be twice as great. No definite period coinciding with the lunar day could be found. The distance between the earth and the moon is of importance and the frequency of earthquakes is 15 % greater at perigee than at apogee if daily readings are used, and 13 % greater when considering the period of five days before and five days after, this difference being due to the increased tidal effect. No definite relation could be established with the moon's age, but the number of earthquakes 12 hours after new moon is four times greater than the number 12 hours before. **R. S. R.**

1948. Lunar Periodicity of Earthquakes. C. Davison. *Phil. Mag.* 17. *pp.* 737–752, *April,* 1934.—Evidence from a large series of observations is adduced in support of periods of 29·6 days with maximum usually near the time of full, or less frequently, new moon; of 14·8 days with maxima usually at times of full and new moon, or less frequently, at the quarters; and of 7·2 days with maxima about midway between the phases. It is suggested that earthquakes due to upheaval should be more frequent at times of new moon, those to depression at full moon. Other possible relations, *e.g.*, as to distinction between earthquakes originating beneath sea and land are discussed. C. A. S.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

1949. Do Lightning Rods Prevent Lightning? J. Zeleny. *Science,* 79. *pp.* 269–271, *March* 23, 1934.—The author here states the two views at present held with regard to protection afforded by lightning rods, viz. (1) that the main function of rods is to prevent lightning, and (2) that their sole purpose is to protect a building in case a stroke occurs. He considers that there are not as yet sufficient data to decide whether the presence of pointed conductors prevents lightning. If the points on lightning rods are to prevent lightning, the rate of flow of electricity from them must equal the rate of regeneration in the cloud. Laboratory experiments lend only a very qualified support to this. Also over a forest where discharges are taking place from myriads of points, trees are frequently struck. He concludes, therefore, that further investigation is necessary before we can say for certain whether the presence of pointed rods on a building decreases the liability of its being struck by lightning. A. E. M. G.

1950. Discharge from Raindrops in Intense Fields. J. J. Nolan and J. P. Ryan. *Gerlands Beitr. z. Geophys.* 41. 2. *pp.* 185–191, 1934. *In English.*—It is shown that the discharge from a water-drop, even when it is of such magnitude that the drop is being dissipated as fine spray, is carried only by small ions. No production of condensation-nuclei or large ions occurs. The bearing of this result on C. T. R. Wilson's theory of the thunderstorm is pointed out. [See Abstract 280 (1930).] AUTHORS.

1951. Atmospheric Ionisation at Glencree. J. J. and P. J. Nolan. *Roy. Irish Acad., Proc.* 41A. 11. *pp.* 111–128, *Oct.,* 1933.—This paper is a continuation of previous work [see Abstract 543 (1932)] dealing with the concentration of ions and condensation nuclei. The results show that the influence of the nuclei on the ionisation is very weak and that no useful formula has hitherto been found linking the two. The effects of rain, temperature and humidity are investigated and only in the case of very heavy rain is there any very marked effect, the number of negative ions increasing considerably, while the number of nuclei decreases on such occasions. No marked annual variation is found in n_+, n_- or n_+/n_-, but a diurnal variation in these quantities has been definitely established. The number of nuclei from thinly populated areas is larger in summer than in winter. An attempt has been made to find a diurnal variation in q, the rate of ion production per c.c., with the result that it appears to be the same at stations as wide apart as Washington and Glencree when referred to a universal time scale. The variation in ion content may be taken as an index of the variation of q. Consideration is also given to the ratio of charged to uncharged nuclei. A. E. M. G.

1952. Summary of the Year's Work, Department of Terrestrial Magnetism, Carnegie Institution of Washington. J. A. Fleming. *Terr. Mag.* 38. *pp.* 323–330, *Dec.*, 1933.—The study of extensive observational material in hand continues [see Abstract 1825 (1933)]. The diurnal variation of declination at Huancayo, on the magnetic equator, varies considerably, even on very quiet days, and at Watheroo on quiet days the horizontal intensity has, on the average, a small diurnal variation. Results indicate that the system of assigning a numerical magnetic character to each day is not altogether satisfactory for the world-wide investigation of activity. In the study of ionisation, the character of the diurnal variation of large ions is found to change with the season of the year, and there is a reciprocal relationship with the manner of variation of small ions. Reflections from the E- and F-layers of the upper atmosphere have been observed, and the virtual heights of the layers determined. The splitting of the echo from the F-layers on the higher frequency is due probably to magnetic double refraction. The disintegration of lithium- and boron-nuclei by high-speed protons has been investigated. An extensive programme in terrestrial electricity is being carried out at the International Polar Year Station, College-Fairbanks, in Alaska. The study of secular changes in the earth's magnetic elements was continued by means of expeditions, and by co-operative work with other organisations. G. E. A.

1953. Anomalies of Terrestrial Magnetism. S. W. Visser. *K. Akad. Amsterdam, Proc.* 37. 2. *pp.* 76–81, 1934.—On account of the various objections to the application of the Gauss method of spherical harmonics to the terrestrial magnetic field, the author investigated it afresh, using the U.S.A. isomagnetic maps. The properties of a "normal field" based upon two adiametrical poles are first obtained and values for the east, north and vertical components calculated. Local anomalies due to important disturbances in the earth are then calculated in terms of the residual components and the results are shown in maps. The values at different parts of the earth are discussed. It is shown that maxima of the positive and negative secular variation all avoid regions with a maximum residual field and are located nearer to the zero lines. R. S. R.

1954. Influence of the Earth's Magnetic Field on Gravity Measurements with Invar Pendulums. H. Lettau. *Zeits. f. Instrumentenk.* 54. *pp.* 101–107, *April*, 1934.—The correction for the effect of the earth's magnetic field on the invar pendulum is small, and can be made to any desired accuracy when the magnetic susceptibility of the material and the elements of the earth's field are known. W. A. R.

See also Abstracts 1917, 1954, 2007, 2009, 2013.

RADIOACTIVITY.

1955. Gamow Theory of Radioactive Disintegration. H. Casimir. *Physica*, 1. *pp.* 193–198, *Jan.*, 1934. *In German.*—A mathematical paper in which it is shown that the Born treatment of Gamow problems leads to an approximate solution of the wave-equation. W. E. P.

1956. Equilibrium Distribution of Radium Products in a Spherical Vessel. W. Mund and A. Luyckx. *Ann. Soc. Sci. de Bruxelles*, 54. *pp.* 24–29, *March* 20, 1934.—In an entirely mathematical paper the authors consider the distribution of RaA, RaB and RaC which are in equilibrium with radon and are contained in a spherical vessel. The fractions of these products which are deposited upon the walls of the vessel are determined and it appears that for ordinary dimensions, the deposition of RaA and RaC is practically entirely on the walls. J. E. R. C.

1957. Energies of α- and γ-Rays. H. A. Wilson. *Roy. Soc., Proc.* 144. *pp.* 280–285, *March* 29, 1934.—It is shown that the energies of disintegration of the radioactive atoms may be arranged in pairs having sums equal to multiples of $3\cdot 8504 \times 10^5$ electron volts. This constant must, therefore, represent some general atomic property, the nature of which is as yet uncertain. AUTHOR.

1958. Half-Value Period of RaD. E. Walling. *Zeits. f. Physik*, 87. 9–10. *pp.* 603–606, *Feb.* 3, 1934.—The paper describes the determination of the half-value period of RaD. The activity of the Ra (D+E) formed from a known quantity of radon was compared with that of a standard Ra (D+E) preparation obtained from a pitchblende of known radium content. The mean of three determinations of the half-value period is 22·3y. W. E. P.

1959. Age of Radioactive Mineral. A. F. Kovarik. *Am. J. Sci.* 27. *pp.* 193–203, *March*, 1934.—Slight numerical alterations (207·98, 205·98, 1·22, and 0·78 for 208, 206, 1·2, and 0·8 respectively) are made in the equation for L′ (amount of ordinary lead + AcD) previously deduced [see Abstract 521 (1931)], and a new equation based on the mass spectrograph intensities of the various isotopic leads is given, whereby the result from the other equations can be checked. The error due to treating AcD as if it were ordinary lead is $\ngtr 0\cdot 1\,\%$. The method is illustrated by calculating the age of uraninite from Wilberforce, $= 1046 \times 10^6$ years. [See Abstract 888 (1932).] C. A. S.

1960. Preparation of Th (B+C). H. Mayerhofer. *Akad. Wiss. Wien, Ber.* 142 2a. 9–10. *pp.* 457–465, 1933.—The paper describes an investigation of the dependence of the electrochemical separation of ThC and Th (B+C) on the temperature of the ThX solution, the concentration, the rate of stirring, the period of activation, and the metal on which the deposition takes place. The most favourable conditions for preparing ThC and Th (B+C) are given. W. E. P.

1961. α-Particle Ionisation Curves. R. Naidu. *Ann. de Physique*, 1. *pp.* 72–122, *Jan.*, 1934.—It is shown that a determination of the Bragg curve is to some extent falsified by multiple scattering and a new apparatus is described in which attention has been paid to this source of error, mainly by careful canalising of the beam. The α-particles from Po and RaC′ are examined and their extrapolated ranges are given as

$3 \cdot 868 \pm 0 \cdot 006$ cm. and $6 \cdot 92 \pm 0 \cdot 01$ cm. respectively. The results indicate that whilst the loss of energy is proportional to the ionisation in the case of the α-particles from polonium, there is an excess of ionisation in the case of RaC′ α-particles. The passage of α-particles from Po through He, Ne, and A was studied in the same apparatus and values are given for the ranges in these gases. It is shown that whereas the loss of energy in He and Ne is almost entirely due to ionisation, in A and air a large proportion (50 % in the case of air) is due to excitation and dissociation. J. E. R. C.

1962. Chemical Effects Produced by α-Particles. W. Mund. *Ann. Soc. Sci. de Bruxelles*, 54. *pp.* 30–35, *March* 20, 1934.—The hypothesis that the chemical effect produced by irradiation with α-particles is due to the formation of ions is discussed, and it is concluded that it is more satisfactory than any other hypothesis which has so far been put forward.

J. E. R. C.

1963. Absolute Determination of the Energy of the Strongest Line in the β-Ray Spectrum of the Active Deposit of Thorium. R. Arnoult. *J. de Physique et le Radium*, 5. *pp.* 67–70, *Feb.*, 1934.—By the method of semi-circular magnetic focussing the most intense line in the β-ray spectrum of the active deposit of thorium is estimated to have an energy of $146 \cdot 88$ ekV corresponding to $HR = 1381 \cdot 0$ gauss. cm. The magnetic field is produced by a pair of Helmholtz coils; its magnitude is determined by balancing the flux (registered by a Chauvin-Arnoux galvanometer) obtained by rotating a coil through 180° in the field, against a flux obtained by reversing a current through a mutual inductance. All the quantities involved were corrected directly against standards at French or English government laboratories. The errors in the determination of H and R are estimated at less than 15 in 10,000 and 3 in 10,000 respectively. The author considers it impossible to obtain a greater precision in magnetic field determination. The results of several workers show a systematic discrepancy in the observed value of a magnetic field according as it is determined by the mutual inductance method or by the Cotton balance method. The values of HR obtained by previous experimenters for this line are Meitner 1385 (1922), Thibaud 1380 (1926), Ellis $1385 \cdot 8$ (1932). F. C. C.

1964. β-Spectra of ThB+C+C″. K. C. Wang. *Zeits. f. Physik*, 87. 9–10. *pp.* 633–646, *Feb.* 3, 1934.—A detailed account is given of the investigation of the β-spectra of ThB+C+C″ and of ThC+C″ by means of a Geiger-Müller counter. The $H\rho$ values of 20 lines and the intensities of 10 lines were measured and the results are compared with those of other observers [see Abstract 554 (1933)]. The present method is more reliable for weak lines. An estimation of the upper limit of the ThB primary β-spectra was made. The paper refers to internal conversion of γ-rays.

W. E. P.

1965. Absorption of Penetrating γ-Rays. W. Gentner. *J. de Physique et le Radium*, 5. *pp.* 49–53, *Feb.*, 1934.—The paper describes measurements, by means of a Geiger-Müller counter, of the absorption in Pb of γ-rays of wave-lengths $4 \cdot 7$, $5 \cdot 9$, $6 \cdot 6$, $7 \cdot 9$ and $9 \cdot 3$ X. The different wave-lengths were obtained by the scattering from Al of the γ-radiation from MsTh, filtered through 3 mm. Pb. The experimental absorption per electron is higher than the theoretical. The results indicate that the additional absorption is zero in the region of 12 X and grows rapidly as the energy of the γ-rays is increased. [See Abstract 141 (1934).] The results are discussed in connection with those of other observers and with the hypothesis that the additional absorption is nuclear and is accompanied by the emission of positron and electron pairs. W. E. P.

1966. Measurement of Strong Polonium Preparations. Elisabeth Kara-Michailova. *Akad. Wiss. Wien, Ber.* 142. 2*a*. 8. *pp.* 421–425, 1933.—A large plate condenser for ionisation measurements of strong Po preparations is described and curves of equal degrees of saturation are given. A comparison of the method with other methods is made. W. E. P.

1967. Portable Detector for Radium. L. F. Curtiss. *Bureau of Standards, J. of Research,* 12. *pp.* 379–382, *March,* 1934.—Apparatus, making use of a simple 2-stage valve amplifier with small ionisation chamber, for detecting lost radium preparations is described. Indications of the approach of the chamber to a preparation appear on a small microammeter mounted in the case of the instrument. With a sensitivity such that 10 mg. of radium produces a deflection of 10 microamperes at a distance of 1 meter, a lost preparation of this size can be located in a large room filled with filing cases, apparatus, etc., in less than 10 minutes. Small B batteries and large flashlight cells are used to energise the dry-cell tubes so that the instrument is entirely self-contained and thus can be used in any location. The total weight is 18 lb. AUTHOR.

1968. Thyratron Counter for α-Particles. H. Teichmann. *Phys. Zeits.* 35. *pp.* 299–301, *April* 1, 1934.—Wynn-Williams [see Abstract 3950 (1932)] has described a method of using thyratrons to increase the rate at which electrical impulses can be counted automatically. When the frequency of the impulses is very high a prohibitive number of thyratrons is necessary and the present paper is concerned with a simple method of obviating this difficulty. The electrical discharges are fed to the anode of the thyratron *via* a rectifying arrangement. A suitable capacity is connected to the anode and this is charged by the rectifier until the potential is great enough for a discharge to take place. By adjustment of the anode capacity the multiplication factor obtained may have any of a wide range of values. It is noted that when using the device to count α-particles, it is necessary to arrange that the output of the preceding amplifier is as far as possible independent of the ionisation produced by the α-particle. J. E. R. C.

1969. Relay Memory for a Thyratron Counter. C. E. Wynn-Williams. *Phys. Soc., Proc.* 46. *pp.* 303–311, May 1, 1934.—The paper describes an automatic mechanism consisting of sixteen interconnected relays and capable of carrying out a complicated cycle of operations in correct sequence in less than half a second. The apparatus is used in conjunction with a valve amplifier and an automatic thyratron counter for the analysis of α-particle groups by means of a magnetic focussing method. The relay mechanism arranges for alternate comparative counts of α-particles to be made under two different sets of experimental conditions, A and B. At the end of a 9-sec. counting period under condition A, a relay memory A records and remembers the thyratron-counter readings; a change-over of experimental conditions from A to B takes place, and another relay memory B restores the thyratron counter to the state at which it stopped at the end of the previous 9-sec. B count, from which point it continues to count under experimental condition B. In the meantime, memory A continues to remember its reading for 10 sec. until the next change-over, when conditions are restored to state A again, the cycle being repeated throughout the course of the experiment. AUTHOR.

See also Abstracts **2144, 2221, 2222, 2223.**

RADIATION.

ABSORPTION AND TRANSMISSION.

1970. Spontaneous Variation of Transmission of Silver Films. A. Jagersberger and F. Schmid. *Zeits. f. Physik*, 88. 3–4. *pp*. 265–269, *March* 19, 1934.—Observations were made on the transmission of sputtered silver films over a period of about five months: in one case the film was kept in the air during this period, in another it was kept in vacuum for the first ten weeks. The variations follow the same course as variations in the electrical resistance, though they are less in magnitude; they appear markedly only in films covering a particular range of thicknesses, and are most marked in a thickness of $5m\mu$. It is suggested that the factors which contribute to the production of the effect are a modification in the structure of the film, the absorption of gas, and chemical change due to exposure to the atmosphere; and it is shown how the results are consistent with this hypothesis. D. H. F.

1971. Chromatic Disperse Two-Phase Systems and Their Use as Light-Filters. E. Knudsen. *Kolloid Zeits.* 66. *pp*. 257–266, *March*, 1934.—A summary is given of previous investigations on disperse two-phase systems, the two phases of which have the same refractive indices but different dispersions for any one colour, so that they appear coloured. From the values of n_D and $n\beta - n\alpha$ for the two phases, it is possible, both graphically and by calculation, to arrive at the colour and at a relative measure for the colour saturation, even when the phases are composed of several constituents. The different possibilities of the representation of such systems are considered, with special reference to the temperature-variation of the colour. Examples are also presented of emulsions invariable with the temperature, and also of new combinations with two solid phases and of liquids dispersed in a solid phase. A method is described for preparing chromatic disperse glasses. T. H. P.

See also Abstracts 1937, 1973, 2021.

COLORIMETRY.

1972. Experimental Colorimetry. J. Guild. *Journ. Sci. Instruments*, 11. *pp*. 69–78, *March*, 1934.—A record of a discourse given at the 24th Annual Exhibition of the Physical Society, in which the elementary principles of colour measurement are dealt with, experiments being performed to illustrate the various points discussed. The experiments are briefly described, and the explanations offered are stated in full, the author finally closing with a brief indication of future development and an experimental demonstration of the photoelectric colorimeter. A note is added dealing briefly with the principles of such a piece of apparatus. R. C. F.

1973. Uniformity of Grades of Lovibond Red Glasses. G. K. Walker. *Bureau of Standards, J. of Research*, 12. *pp*. 269–282, *March*, 1934.—The need for uniformly graded Lovibond red glasses has long been urgent among those engaged in the vegetable- and cottonseed-oil trade. Huge quantities of oil are yearly bought and sold with colour as an important contributing factor in the rules governing the transactions. The grade of the oil depends upon its colour and the colour is defined in terms of Lovibond glasses. The calibration of these red glasses in terms of the standard unit and scale, known as the Priest-Gibson unit and scale, has been in progress at the Bureau of Standards since 1928. By direct comparison with the working standards a new value or regrade numeral is assigned to each glass submitted for test. The new value is the effective additive value when the glass is used in combination with a 35-yellow (35Y) glass. The direct-comparison method of calibration and the apparatus are described. The statistical investigation of the data resulting from the calibration of the first 1000 red glasses shows that variations of a whole unit frequently exist among glasses of similar Lovibond numeral. The several illustrations display in different ways the discrepancies found among these glasses. AUTHOR.

1974. Condensed Tables for Colour Computation. T. Smith. *Phys. Soc., Proc.* 46. *pp.* 372–380; *Disc.*, 380–383, and 478–480, May 1, 1934. —It is sometimes sufficient in the spectrophotometry of coloured materials for the determination of their colour co-ordinates on the C.I.E. system to take measurements at intervals of 10mμ instead of the standard interval of 5mμ. Special tables have been computed for use in these cases which give with less labour results indistinguishable from those which would be obtained from the use of the standard observer tables. AUTHOR.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

1975. Kerr Effect of Benzene Derivatives. G. Otterbein. *Phys. Zeits.* 35. *pp.* 249–265, *March* 15, 1934.—Measurements of the Kerr effect of dilute solutions were made in order to obtain expressions for the anisotropy of the free molecules. A formula is derived for the purpose of extrapolating to infinite dilution, and this has been done using acetone as an example. A method is given of predicting both experimentally and by calculation the Kerr effect of dichlorbenzene from that of benzene and monochlorbenzene. A simple apparatus involving the Brace compensation method is described by means of which Kerr effect measurements may be made with sufficient accuracy. A calculation on the lines of Silberstein's theory throws some light on the fact that the Kerr effect is greatly influenced by the solvent, but does not give a direct explanation of this phenomenon. The example of naphthalene and its α and β derivatives shows that a simple addition of the polarisation is not always possible. In most cases Silberstein's theory assists in giving a qualitative explanation of the Kerr constants. R. L.

1976. Magnetic Rotatory Dispersion of Thiophene, Furane, Pyrrol and Benzene. P. Preiswerk. *Helv. Phys. Acta,* 7. 2. *pp.* 215–223, 1934. *In German.*—Rotatory dispersion data are recorded for these three compounds over the range of wave-lengths in which they are completely transparent. C. B. A.

1977. Magnetic Rotatory Power of Hydrogen Selenide. R. de Mallemann and P. Gabiano. *Comptes Rendus,* 198. *pp.* 1030–1031, *March* 12, 1934.—The value of Verdet's constant [$\lambda = 5{\cdot}78 m\mu$, at 0° C and 760mm. pressure] for H_2Se is found to be 61×10^{-6} minute. The molecular rotation has the value 40×10^{-5} radian. This result indicates that the atomic rotation of Se is appreciably greater than that of S. J. S. G. T.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

1978. Transformation of Light of Long Wave-Length into Light of Short Wave-Length. G. Holst, J. H. de Boer, M. C. Teves and C. F. Veenemans. *Physica, I. pp.* 297–305, *Feb.*, 1934. *In English.*—A description is given of an apparatus by means of which an image, projected upon a photoelectrically sensitive layer, is transmitted simultaneously by means of the photoelectrons to a transparent fluorescent screen. Since the photoelectric kathode layer is sensitive to the red and infra-red, whereas the fluorescent anode (made of calcium tungstate) emits visible light, the arrangement effects a transformation of long-wave light into shorter-wave light. In this way an image projected in infra-red light can be photographed with plates that are sensitive to blue light, or can be observed directly by the eye. Examples are reproduced of photographs obtained with the apparatus, as compared with photographs obtained directly with visible light. L. A. W.

1979. Polarisation of Fluorescence. Part I. Solutions of Dyestuffs. S. M. Mitra. *Indian Journal, Phys.* 8. *pp.* 171–188, *Dec.* 15, 1933.—A detailed examination has been made on the influence of the following factors on the polarisation of the fluorescence of some dyestuffs: (1) Wave-length of exciting light, (2) Viscosity of solution, (3) Temperature, and (4) concentration. A report of results is given, for which the original paper should be consulted. J. E.

1980. Molecular Scattering of Light in Fluorescent Liquids. E. Canals and P. Peyrot. *Comptes Rendus*, 198. *pp.* 746–749, *Feb.* 19, 1934.—Fluorescence is a cause of error in the determination of the polarisation factor in the light scattered in liquids, since the fluorescent light is not appreciably polarised. It is possible to determine the relative intensity of the fluorescence by the method of screen displacement. If a screen, cutting off the light which excites fluorescence, is placed on the light side of the cell, the factor of depolarisation ρ gives i/I where i is the intensity minimum and I is the intensity maximum of the two rectangular components constituting the scattered light. If, however, the screen is placed on the observation side, the fluorescence is excited and the depolarisation factor is given by $\rho^1 = i + f/I + f$. From these two relations we get $2f/(I + i) = 2(\rho + \rho^1)/(1 - \rho^1)(1 + \rho)$. This method has been here applied to the determination of the variation with concentration of the fluorescence of quinine sulphate in solution. It is found that (1) ρ is constant for all concentrations of quinine sulphate in very dilute solutions, and (2) $2f/(I + i)$ is a linear fuuction of the concentration and as $(I + i)$ is practically constant this means that the intensity is a linear function of the concentration, *i.e.*, the specific fluorescent power of quinine sulphate is constant. J. E.

1981. Emission of Lenard Phosphors. E. Loës. *Ann. d. Physik*, 19. 5. *pp.* 489–500, *March*, 1934.—The phosphors were excited by light from a Hg vapour lamp and by kathode rays. In the latter case arrangements were made to work at low temperatures. Emission bands were found down to the sensitivity limit of the plates ($950\mu\mu$). The infra-red bands are similar in character and properties to the visible bands and show a similar shift to the violet with decreasing temperature. No general quantitative survey is deemed possible at the present stage. J. E.

1982. Thermoluminescent Spectra of Fluorites. Part IV. E. Iwase. *Inst. Phys. & Chem. Research, Tokyo, Sci. Papers No.* 486. *pp.* 212–223, *Feb.*, 1934.—A continuation of previous work [see Abstract 1104 (1934)]. The spectra of natural thermoluminescence was compared with that given after destruction with heat and restoration with X-rays. According to the present results and those previously described fluorites may be divided into three classes: (1) In which the thermoluminescence may be restored unchanged, (2) In which a change of relative intensities of bands occurs, and (3) In which new bands appear. Restored thermoluminescence can usually be driven out at a lower temperature than natural thermoluminescence. J. E.

1983. Cathodoluminescence Spectra of Fluorites, Calcites and Synthetic Phosphors Containing Samarium. J. Yoshimura. *Inst. Phys. & Chem. Research, Tokyo, Sci. Papers No.* 487. *pp.* 224–247, *Feb.*, 1934. *In English.*—Inspection of the line-like bands attributed to rare earths led to the identification of the activators. In general, green fluorites contain numerous earths while fluorites of other colours contain only a few; *i.e.* colourless or violet samples are comparatively pure. There appears to be no correlation between colour and any particular rare earth. The calcite spectra usually consists of a broad orange band with two intensity maxima at 6050–5950 Å and at 6310 Å *circa*, which is ascribed to Mn. The spectra given by GaO from calcined thermoluminescent calcites show additional line-like bands due to rare earths. The CaO obtained from nonthermoluminescent calcites show no such lines, indicating that the thermoluminescence is attributable to rare earths. In the fluorides of alkaline earths, containing Sm, it is noted that most lines are shifted towards the blue as the lattice constant of the base increases except for two weak lines which shift towards the red. It is also concluded that for the fluorescence of carbonates it is not necessary to have oxide present and that the oxide and carbonate spectra are clearly different. J. E.

See also Abstracts 1998, 2081, 2134.

INTERFERENCE. DIFFRACTION AND SCATTERING.

1984. Integral Equations for Electromagnetic Waves. V. Kupradze. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 1·4. *pp.* 161–165, 1934. *German Abstract.*—Integral equations are derived for the solution of two-dimensional problems involving the diffraction of electromagnetic waves at any closed contour, and problems involving the eigenvibrations of finite regions. [See following Abstract.] W. S. S.

1985. Proofs of Existence and Uniqueness in Diffraction Theory. V. Kupradze. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 1. 5. *pp.* 235–240, 1934. *In German.*—Establishes theorems derived in a previous paper [see preceding Abstract]. W. S. S.

1986. Diffraction with Wide Source. F. Wolfers. *Comptes Rendus*, 198. *pp.* 924–925, *March* 5, 1934.—The diffraction figures obtained when a straight-edged screen is illuminated through a parallel slit of variable width, consisting of the ordinary and supplementary fringes, are described [see Abstract 992 (1926)]. C. A. S.

See also Abstracts 1844, 1980, 2003, 2017, 2025.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

1987. Correlation of the Photosyntheses of Phosgene and Hydrogen Chloride. G. K. Rollefson. *Am. Chem. Soc., J.* 56. *pp.* 579–583, *March,* 1934.—The photochemical reactions of Cl_2 with H_2 and CO, yielding HCl and $COCl_2$ respectively, proceed by chain mechanisms, each consisting of a pair of reactions, one of which uses up Cl atoms, whilst the other forms them. The active form of Cl involved in the chain process is the same in the two cases, and consideration of the mechanism of the formation of $COCl_2$, together with certain theoretical calculations, indicates the formula Cl_3 for this intermediate agent. Such formula is found to be consistent with the observations on the temperature-coefficient of the formation of HCl and the available data point to the value 5 ± 1 k.cal. for the heat of dissociation of Cl_3 into $Cl_2 + Cl$. T. H. P.

1988. General Density Curves for Linear Response. W. Pistor. *Zeits. f. techn. Physik,* 15. 3. *pp.* 107–112, 1934.—In sound recording by photographic means a linear relation is required between the intensity and the opacity to give distortionless reproduction. In practice there are 4 general types of curve; these are illustrated by typical density-log. exposure curves. The relations between the curves are discussed and a transmission factor is defined which can be obtained by a graphical method from the density-log. exposure curve. H. J. H. S.

1989. Effectiveness of Photographic Developers in Comparison with Metol-Hydroquinone. J. Cuenat. *Zeits. f. wiss. Phot.* 32. *pp.* 239–256, *Feb., and pp.* 257–277, *March,* 1934.—In order to determine whether it is possible completely to replace present developers by metol-hydroquinone, or its components, the developing properties of a number of other developers were examined. Velocity, fogging action, threshold value, gradation, adaptability, permissible illumination variations, reproduction of detail, covering power, and permanence of the solution are considered, the methods of determining these factors from blackening curves being indicated. The results obtained show that metol-hydroquinone developers do completely replace other developers. R. C. F.

1990. Criterion of the Speed of Emulsions for Modern Requirements. F. Lapeyre. *Soc. Franç. Phot. et Ciné., Bull.* 20. *pp.* 269–270, *Dec.,* 1933.—Suggests the use of a gradation number of 0·9 instead of that of 1·2 previously given [see Abstract 2370 [(1933).] This number corresponds to a γ of 0·6 and the reduction thus obtained has the effect of reducing fog and granulation, avoids the obtaining of very harsh negatives from subjects of large contrast, and reduces to a minimum the opacity of negatives accidentally over-exposed. Finally, modifications in the previous method, occasioned by this change in gradation number, are indicated. R. C. F.

1991. Theory of the Ideal Colour Sensitivity of Photographic Materials. Part II. J. E. de Langhe. *Zeits. f. wiss. Phot.* 32. *pp.* 283–288, *March,* 1934.—From the theory for the ideal colour sensitivity already developed [see Abstract 4057 (1933)] the author mathematically determines the conditions which must be satisfied by the ideal correction filter, and thus derives the spectral transmission of the filter. It is shown that the results obtained are not in agreement with those given by methods previously used. R. C. F.

1992. Kinetics of Reaction Between Silver Bromide and Photographic Sensitisers. B. H. Carroll and D. Hubbard. *Bureau of Standards, J. of Research,* 12. *pp.* 329–344, *March,* 1934.—The kinetics of the reactions of silver bromide with sensitising materials have been studied for comparison with the process of photographic sensitisation by the same compounds. Sodium sulphite, reacting with silver bromide to give metallic silver, and allyl thiocarbamide, reacting with it to give silver sulphide, were chosen. The reactions were followed by change in bromide ion concentration. Data on solubility and adsorption were obtained to assist in interpretation of the results. The reaction with allyl thiocarbamide is autocatalytic; under the conditions of the experiments it appears to take place by decomposition of dissolved material at the surface of the silver sulphide. The sulphite reaction is also autocatalytic, and it seems probable, on theoretical grounds, that this is an essential characteristic of the sensitisation process. AUTHORS.

1993. Electrolytic Desensitisation. E. Baur. *Zeits. f. Elektrochem.* 40. *pp.* 184–188, *April*, 1934.—The effects of retarding agents—desensitisation, inhibition, fluorescence-extinction—would appear to have a common cause, which is regarded as a reaction-circle between the light-sensitive substance (sensitiser) and the desensitiser, which may oscillate between two valency (oxidation) stages. The desensitised reaction velocity v is related to the concentration of the desensitiser (D) by the equation: $v=1/(0\cdot01+\beta D)$. Electrolytic desensitisation has been studied by means of the reaction between uranyl sulphate and formic acid and the photolysis of potassium ferric oxalate, the calculated and observed values of v agreeing satisfactorily. It is concluded that, in photolytic desensitisation, the sensitiser S, which by taking up a light quantum $h\nu$ passes into the phototropic state S_L, reverts to its dark condition S_D by the desensitiser D oscillating between its oxidised state D_O and its reduced state D_R. This is, therefore, a circular reaction maintained by the light energy. [See Abstract 3242 (1932).] T. H. P.

1994. Action of Ultrasonic Vibrations on Photographic Emulsions. B. Claus. *Zeits. f. techn. Physik*, 15. 2. *pp.* 74–79, 1934.—Previous results show that with non-photographic emulsions ultrasonic vibrations produce very homogeneous, stable and highly concentrated forms. The results obtained by the present author show that the effect of such vibrations is to produce a very homogeneous silver halide gelatin emulsion, the homogeneity being dependent upon the duration of the vibrations and upon the part of the process at which they are applied. Photographic emulsions are also made very stable, and are concentrated if acted upon by ultrasonic vibrations. Finally, the variations of the photographic properties of the emulsions are examined, results indicating that the resolving power of the emulsion is unaffected by such vibrations, the general sensitivity and colour sensitivity being increased. R. C. F.

1995. Effect on the Latent Image of Post-Heating and of Melting the Gelatin. A. J. Reardon and H. P. Griggs. *J.O.S.A.* 24. *pp.* 85–90, *March*, 1934.—In general the application of heat to the photographic emulsion results in an increase in the sensitivity, regardless of whether pre- or post-heating is employed. In the present paper the effects produced by heating the plates in an oven saturated with water vapour are examined. The results obtained show that treatment after exposure in warm water at 45° C. for 5 sec., and then, after drying, heating in the oven for a period of 30 min. at different temperatures, always results in a decrease in density, the decrease being greater the higher the oven temperature. Oven treatment without previous warm water treatment results in an increase in latent image density up to 70° C. after which a falling off in the density

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is indicated. Heating at a constant temperature for various times results in a decrease in density if the strips had been water-treated before going into the oven, whilst an increase in density is again obtained for test strips not water-treated. The maximum increase is obtained with 30 min. heating at 70° C., whilst the increase in density is neutralised at some point between 30 and 45 min. heating, after which a decrease in latent image density is again obtained. Finally, it is shown that warm water treatment alone results in a decrease in density. The results are explained by considering that the heating or warm water treatment produces a gelatin flow which results in the AgBr crystal cracks, developed by the light, being partially filled by gelatin, thus offering a silver-bromide gelatin surface to the developer instead of the usual silver-bromide surface. In the case of the oven treatment only, cracks are developed by the heat, but it is not until a temperature of 70° C. has been applied for 30 min. that the gelatin flows and partially fills the cracks. The results also show that the lower the initial density the smaller is the effect due to post-heating. R. C. F.

1996. Gas-Discharge Lamps for Dark-Room Lighting. H. Bertling. *Fot. Indust.* 32. *pp.* 389–390, *March* 28, *and pp.* 415–417, *April* 4, 1934.—Deals mainly with the question of dark-room illumination when working with infra-red sensitive emulsions, although the possibilities of using sodium vapour and neon gas-discharge lamps for normal types of photographic emulsions are briefly discussed. Spectrograms of Agfa and Kodak infra-red sensitive emulsions, obtained with various sensitisers, show that there is a region, between 500-600 mμ approximately, in which such emulsions are non-sensitive, and a suitable dark-room illuminant is obtained by using a neon lamp in conjunction with the Agfa filter No. 114. Line spectra of Tl, Na, Mg and Hg vapour lamps are compared with the spectral sensitivity of the various Kodak emulsions, the most useful lamp being the Tl vapour lamp. All, however, have parts of their spectra which must be absorbed, and filters suitable for use with Tl, Na and Hg vapour lamps are given. R. C. F.

1997. Photographic Intensity Measurement with Moving Electron Beams. F. C. Poultney and R. Whiddington. *Leeds Philosoph. & Lit. Soc., Proc.* 2. *pp.* 492–494, *Jan.*, 1934.—Whiddington and Taylor have shown that oiled photographic plates become much more sensitive to electron action, but the law of photographic action is the same as for light irrespective of whether the plate is oiled or not. The present paper describes the method adopted in the comparison of electron streams of very different intensities, so that for equal values of the exposure time the values of the photographic blackening are incomparably different. The film is made to move past the electron stream, incident normally upon it, and the speed of the film is automatically recorded by jerking aside the electron beam from its normal position. The density is again found to be a linear function of the log. of the exposure time. [See also Abstracts 3718 and 4263 (1932).] R. C. F.

1998. Blackening of Photographic Plates by Electrons and Electron-Excited Fluorescence. B. v. Borries and M. Knoll. *Phys. Zeits.* 35. *pp.* 279–289, *April* 1, 1934.—The results of previous workers are summarised briefly in a series of curves showing the blackening as a function both of the charge density (coulombs/cm^2.) and the working thickness for potentials from 40 to 80,000 volts and for exposures from 10^{-2} to 10^2 sec. It appears that, for each emulsion, there is an optimum potential for which (at constant charge density) the blackening is a maximum. This potential is of the order of 60 kV. For potentials of 1 to 10 kV the blackening is approximately constant for a range of charge density from 10^{-9} to 10^{-8} coulomb/cm.^{2} and for potentials of less than 1 kV, the blackening increases slowly with increase in charge density. With the aid of kathode ray oscillographs, the work has been extended to include exposures of 10^{-5} to 10^{-8} sec. No optimum potential for maximum blackening is found up to potentials of 80 kV; for the same charge densities the longer exposure gives the greater blackening. The sensitivity of various emulsions is considered. Blackening due to electron-excited fluorescence is examined for short exposures and the influence of the thickness of coating of the fluorescent material is discussed. The minimum energy required for blackening by electrons and by fluorescence is studied as a function of the accelerating potential. For potentials exceeding 20 kV the energy is approximately constant, but for smaller potentials the energy required increases rapidly as the potential is decreased. The photochemical efficiency of the blackening process is discussed. H. J. H. S.

See also Abstracts 1791, 2019, 2185.

PHOTOMETRY.

1999. Opacity of Paper by the Contrast-Ratio Method. D. B. Judd. *Bureau of Standards, J. of Research,* 12. *pp.* 345–351, *March,* 1934.—Contrast ratio of a paper sample is defined as the brightness of the illuminated sample when backed by a black-lined cavity divided by its brightness when backed by a surface of magnesium oxide. In practice other less fragile surfaces are substituted for the MgO surface, and to protect these substitute surfaces as well as the paper samples themselves the samples are kept from touching the surfaces. Both departures from the definition are potential sources of error. These errors have been investigated experimentally and a theoretical expression representing them is given. AUTHOR.

2000. Semi-Automatic Light Distribution Photometer. G. H. Wilson and W. Weir. *Journ. Sci. Instruments,* 11. *pp.* 114–115, *March,* 1934.—A description is given of a simple form of semi-automatic photoelectric photometer for rapidly obtaining polar curves of light distribution from lamps or lighting fittings. AUTHORS.

2001. Recording Microphotometer. J. Weigle. *Arch. des Sciences,* 15. *pp.* 484–494, *Nov.-Dec.,* 1933.—Describes a new instrument, aiming at cheapness, in which the light pencil after passing through the photographic plate (which is traversed) enters a photoelectric cell, the photoelectric current being amplified and passed finally to the galvanometer. The novel feature of the instrument is that the galvanometer is rotated bodily, the recording paper being kept fixed. The rotation of the galvanometer necessitates the use of a less sensitive instrument than usual, but this drawback is overcome by the use of a greater amplification of the photoelectric current. An advantage of the less sensitive galvanometer is the increased recording speed which becomes possible. W. S. S.

2002. Recording Microphotometer Requiring no Amplification. C. Sannié. *Comptes Rendus,* 198. *pp.* 1149–1151, *March* 19, 1934.—A simple form of microphotometer which requires neither slits nor amplification is described. A reduced image of a small intense rectilinear filament (6 W) is projected through a small stop on to the plate under examination, a microscope being used for accurate adjustment of the position of the image filament. The microscope eyepiece is then replaced by a selenium cell of high sensitivity. Cells of the Lange and Bergmann type are used; these give a response which is proportional to luminous flux over a large range, and they have an internal resistance of the order of 5–10,000 ohms. The cell response is of the order of 40 μA per lumen; this is recorded on a high sensitivity galvanometer. The lag is small (fraction of a second) if a specified filter is mounted in front of the cell. The amount of scattered light present is negligible. H. J. H. S.

2003. Resolving Power with a Microphotometer. R. W. Ditchburn and E. J. Power-Steele. *Roy. Irish Acad., Proc.* 41A. 13. *pp.* 137–149, *Nov.*, 1933.—Experiments are described which were designed to test the practical resolving power of an optical system when photographic methods are used in conjunction with a microphotometer. The effects on the resolution produced by exposure time, prefogging, and other factors are investigated, and the resolution of lines of different intensity ratio is examined. An increased resolution produced by stopping out central portions of the lens is shown. A new "characteristic curve" is suggested for use in connection with a deflection microphotometer. [See also Abstract 812 (1931).] C. B. A.

2004. Photographic Spectrophotometry. M. Duffieux and L. Grillet. *Rev. d'Optique*, 12. *pp.* 425–448, *Nov.*, 1933.—The use of a spherical lens and a stepped diaphragm in between the light source and the slit of the spectrograph introduces systematic errors, due to the conjugation of the graduation system and the dispersive system. In order to simplify the optical system and the calculation of the corrections, the cylindrical lens and the stepped diaphragm are placed inside the spectrograph, the diaphragm in between the collimator and the prism, and the cylindrical lens near to the photographic plate. This system, however, introduces aberrations, which upon examination are found to be considerably decreased by reducing the slit length. The corrections for the absorptions of the prisms are easy to determine, and the method of deriving them is given. Finally, certain applications of the apparatus are given, viz., sensitometry by means of graduated spectra, juxtaposition of two spectra and comparison of two light sources. R. C. F.

2005. Photoelectric Spectrophotometer using Dual Electrostatic Compensation. L. A. Woodward. *Roy. Soc., Proc.* 144. *pp.* 118–128, *March* 1, 1934.—The apparatus described is suitable for the measurement of extinction coefficients of substances in solution, more particularly for wave-lengths in the ultra-violet region. Monochromatic light is split into two beams (by a partially platinised quartz plate) which pass to two photoelectric cells, one beam direct, the other through the solution. The photoelectric current from each cell charges a condenser, an external voltage being applied to the other condenser plate to keep the potential of the cell kathode constant. If this is done for both cells, the ratio of the external voltages applied to the two condensers measures the ratio of the beam intensities. Tests on KNO_3 solutions gave values for the beam intensity ratio I_0/I with an error of less than 1·3 % (I_0/I varying from about 1·6 to 10). W. S. S.

POLARISATION.

2006. Rotatory Power and Absorption of Isosteric Molecules. P. Preiswerk. *Helv. Phys. Acta*, 7. 2. *pp*. 203–214, 1934. *In German.*—The absorption spectra of benzoin, methyldesoxybenzoin and desyl chloride are measured, and the rotatory dispersion of the first two compounds is recorded, readings being made through the range of wave-lengths covered by the ketonic absorption bands exhibited by them. The partial rotation due to this band is successfully calculated by Kuhn's method, and the anisotropy factor for the band determined. The OH group in benzoin, as compared with the corresponding CH_3 and Cl radicals in the other two compounds, has a strong effect on the absorption, strengthening the weak CO band and reducing its half-width. The anisotropy of the CO band, which essentially controls the rotatory dispersion in the visible spectrum, is slightly reduced in the case of benzoin, where the intensity of the band is greatest. C. B. A.

See also Abstracts 1979, 2015.

RADIATION, EMISSION.

2007. Heinrich-Hertz-Gesellschaft Wireless Expedition to Tromsö. K. W. Wagner. *E.N.T.* 11. *pp*. 37–50, *Feb.*, 1934.—A short account is given of the main features of the work carried out at Tromsö by members of the Heinrich-Hertz-Gesellschaft expedition during the International Polar Year. The work was chiefly concerned with (1) photoelectric measurement and registration of the brightness of the North light, (2) registration of the field strengths and directional variations of the transmissions from European broadcasting stations, and (3) further development and application of apparatus for echo recording. The apparatus used in this work is described and a few typical records are given. Comparison of records for the first half of 1933 showing (*a*) daily mean values of magnetic disturbances, (*b*) reflecting power of the Kennelly-Heaviside layer, (*c*) field strength of the Breslau broadcasting transmitter (325 m.) and (*d*) directional variations for the same transmitter, exhibit complete dissimilarity of behaviour of the magnetic disturbance values and the other three quantities. A 27-day period is also indicated. The results are briefly discussed. A. W.

2008. Cosmic Ray Deflection Experiments. W. E. Danforth, Jr. *Frank. Inst., J.* 217. *pp*. 331–345, *March*, 1934.—The magnetic deflection experiments with coincidence counters, performed by Mott-Smith and by Curtiss [see Abstracts 2948 (1932) and 1466 (1933)] are subjected to a geometrical analysis. The method is extended to include a constant loss of energy per unit path length as a particle traverses an iron core. Curtiss' observations which were conducted with no iron present are considered to indicate that if all the radiation consists of positive and negative electrons the fraction between 2×10^7 volts and $1 \cdot 5 \times 10^8$ volts is less than 30 % of the total above 2×10^7 volts, and that the fraction between 2×10^7 and 10^9 volts is greater than 30 %. It is concluded that Mott-Smith's experiment is indefinite due simply to absorption of rays by the iron, and that comparison of the two types of experiments yields no decisive information of the intensity of the magnetic field B or H within the iron. F. C. C.

2009. Path of a Secondary Cosmic-Ray Charged Particle in the Earth's Magnetic Field. I. S. Bowen. *Phys. Rev.* 45. *pp*. 349–351, *March* 15, 1934.—An analysis is made of the paths of secondary high energy charged particles ejected from the earth's atmosphere by primary cosmic-ray photons. This leads to the following conclusions. (1) As has generally been assumed the decrease in ionisation in equatorial regions is much larger than can be explained by the deflection by the earth's magnetic field of the secondaries formed in the earth's atmosphere. (2) The observed east-west dissymmetry of Geiger tube counts can be explained by the deflection of secondaries formed in the earth's atmosphere provided an appropriate value of Q, the excess of positives over negatives, may be assumed. The small amount of the observed dissymmetry at high latitudes however sets so low an upper limit on Q that this mechanism appears to be inadequate to explain all of the observed dissymmetry at low latitudes.

AUTHOR.

2010. Mechanism of Cosmic-Ray Counter Action. C. D. Anderson, R. A. Millikan, S. Neddermeyer and W. Pickering. *Phys. Rev.* 45. *pp.* 352–363, *March* 15, 1934.—A study of photographs taken in a very powerful magnetic field with the aid of a cloud chamber activated by counter responses shows (1) that such an arrangement has a strong selective action on showers ; (2) that showers so selected have an exceptional multiplicity of tracks ; (3) that the two counters show simultaneous responses when no single particle can pass through both of them ; that in general these showers consist of a mixture of positive and negative electrons rather than of electrons and protons, no effects certainly attributable to neutrons being observed ; (5) that these electrons in getting out of the nucleus sometimes produce an intense photon spray of the nature of *brems strahlung* ; (6) that these photon sprays are increasingly responsible for the simultaneous activation of the two counters the thicker the intervening lead ; (7) that a light element like carbon has little effect in producing either showers or sprays ; (8) that the total energy of a shower is not larger than that of single electrons (+ or −) ; (9) that the Dirac theory encounters certain difficulties in accounting for the observed effects.

AUTHORS.

2011. Cosmic Ray Ionisation at High Altitudes. A. H. Compton and R. J. Stephenson. *Phys. Rev.* 45. *pp.* 441–450, *April* 1, 1934.—Prinary cosmic rays may be interpreted as (1) photons, if at all altitudes $d^2(\log\psi)/dP^2 > 0$ where P is the barometric pressure and ψ is the intensity as a function of the pressure for rays descending vertically through the atmosphere, (2) ionising particles with a definite range (r-particles) if $d^2\mathrm{I}/d\mathrm{P}^2 > 0$ where I is the observed intensity. Measurements by a recording cosmic ray meter with walls equivalent to 6 cm. of Pb to avoid transition effects were made on the recent Settle-Fordney stratosphere balloon flight. Through the altitude range 40 to 15 cm. the results favour the corpuscular hypothesis. Two distinct range groups are found. Group A is of short range and is almost completely confined to the upper atmosphere. It probably consists of particles which are neutral or which have a high ratio of mass to charge. Group B has ranges greater than the air equivalent of 27 cm. Hg with a strong maximum at 36 cm. Protons or possibly positive electrons with such an energy would be able to penetrate the earth's magnetic field. Comparison of high altitude data show that the equatorial cosmic rays are closely similar to the magnetically deviable rays both in their absorption in air and in their transition effects. The results are considered to indicate that most of the cosmic rays which reach the earth are probably protons, any primary cosmic ray protons present producing an imperceptible effect. [See following Abstract.]

F. C. C.

2012. Form of the Cosmic-Ray Depth-Ionisation Curve. C. Eckart. *Phys. Rev.* 45. *pp.* 451–453, *April* 1, 1934.—On the assumption that cosmic rays are absorbed exponentially, it is shown that the absorption of a homogeneous beam in the wall of a spherical ionisation chamber can be approximately represented by a factor $exp(-kd)$ where k is the absorption coefficient and d is the effective wall thickness which is independent of k. The transition effects in the atmosphere and in the wall of the chamber are then treated and it appears that if the effective wall thickness is great enough, the depth-ionisation curve should be concave upward at every point. The experiments of Compton and Stephenson [see preceding Abstract] do not confirm this prediction and it is concluded that the assumption of exponential absorption is not capable of accounting for the facts in their entirety. F. C. C.

2013. Thunderstorms and Penetrating Radiation. E. C. Halliday. *Cambridge Phil. Soc., Proc.* 30. *pp.* 206–215, *April* 30, 1934.—The expansion of a cloud chamber is synchronised by a mechanism of the Blackett and Occhialini type [see Abstract 2382 (1933)] with a lightning flash in order to detect the penetrating radiation apparently produced in thunderclouds. A correlation is established and the results are in fair agreement with those obtained by Schonland and Viljoen [see Abstract 2996 (1933)] in South Africa. When the two observations, effectiveness of western storms and arrival of particles from the north are combined it becomes probable that the penetrating radiation track is that of an electron which was initially projected upwards but has returned under the action of the earth's magnetic field. F. C. C.

See also Abstracts 1946, 1984, 2101.

RADIATION, GENERAL THEORY.

2014. Particles Associated with the Propagation of Light Waves. A. Proca. *Comptes Rendus,* 198. *pp.* 643–644, *Feb.* 12, 1934.—It is shown that a certain type of particle differing from photons only in that they possess a spin of amount $\frac{1}{2}h/2\pi$ instead of 0 or $h/2\pi$, can be associated with any light wave. These particles have no rest mass, and obey Dirac's equations. The energy of the particle $W = h\nu$, may be positive or negative the light being right-handed or left-handed circularly polarised, respectively, in these two cases. Linearly polarised light ceases to be the simplest type of light wave, for it corresponds to a superposition of two states of the particles having equal energy values but of opposite sign. W. S. S.

See also Abstract 1859.

RADIATION, MECHANICAL EFFECTS.

2015. Couple Exerted by Circularly Polarised Light. E. Henriot. *Comptes Rendus,* 198. *pp.* 1146–1148, *March* 19, 1934.—Classical reasoning leads to the conclusion that a circularly polarised wave carries a longitudinal impulsive moment of magnitude energy/frequency. The couple exerted on a half-wave lamina is deduced and a possible interference method of verifying the theoretical deductions is suggested, but it is shown that the effect is so small that other disturbing factors would render measurements impossible. H. J. H. S.

REFLECTION. REFRACTION AND DISPERSION.

2016. Optical Properties of Metals. N. F. Mott and C. Zener. *Cambridge Phil. Soc., Proc.* 30. *pp.* 249–270, *April* 30, 1934.—A simplified treatment is given of the quantum theory of the optical properties of metals. The theory is compared with the available experimental results in considerable detail, stress being laid on the information regarding the metallic structure which is obtainable from the optical properties. The type of experiment which is likely to yield information of interest theoretically is also discussed. A. H.

2017. Highly Reflecting Films of Zinc Sulphide. A. H. Pfund. *J.O.S.A.* 24. *pp.* 99–102, *April*, 1934.—The initially high reflection from zinc sulphide is still further enhanced by constructive interference in thin films. By distilling sphalerite *in vacuo*, thin films showing first order interference and reflecting white light brilliantly are produced. The application of such films to the metallographic microscope, Michelson interferometer and other instruments is discussed. AUTHOR.

2018. Focal Isolation. R. W. Ditchburn. *Roy. Irish Acad., Proc.* 41A. 14. *pp.* 150–155, *Nov.*, 1933.—The possibility of applying the method of focal isolation, employed by Rubens and Wood in the infra-red, to visible and ultra-violet wave-lengths by means of combinations of lenses is investigated, and it is shown to be of no practical use in these regions of the spectrum. An alternative arrangement is suggested which might be practicable. C. B. A.

2019. Distortion in Air Camera Lenses. R. H. Field. *Canad. J. of Research*, 10. *pp.* 239–243, *Feb.*, 1934.—For map-plotting purposes it is essential to know the principal distance (focal length) of air cameras, preferably for rays making various angles with the lens axis. A compact apparatus has been developed for making the necessary measurements and has been used for investigating the lens distortion in a number of air cameras. This method of finding distortion has the advantage that it takes into account the effect of the glass plate fitted in film cameras to maintain the film flat during exposure. The distortion is given as the linear displacement in the plane of the photograph. It is felt that in this form the results are of more interest to those using air photographs. By simple calculations the figures can be changed to give the distortion in the forms more usual in the treatment of lens design. AUTHOR.

2020. Refractive Index of Small Specimens. A. Biot. *Ann. Soc. Sci. de Bruxelles*, 54. *pp.* 5–13, *March* 20, 1934.—The methods examined are primarily that of minimum deviation and secondarily those of grazing incidence and classical interference. For solids immersion methods give a precision of 1×10^{-5} for the refractive index while that of grazing incidence can be used for a small quantity of a liquid if the surface is large but not so easily for solids if the facets are of irregular shape. Working on the experimental limits of precision of optical points, the error dn is related to the length of side, l (mm) of the prism by the relation $dn=(1-\sin\frac{D}{2})/l\times1\cdot6\times10^5\ \sin^2\frac{A}{2}$, where A is the refracting angle of the prism, D the deviation and G the magnification, such that $l=0\cdot5$ G. The defects of the surface are a minimum for A = 60°. The method has special application for finding values of n for lenses. The three methods studied require for each degree of precision a minimum volume for the body tested. These volumes, relatively very small, are of the same order of magnitude for the three methods respectively to 1×10^{-4} for 1 mm^3 of a liquid or a prism side of 0·4 mm. or to 1×10^{-5} for 0·5 cm.^{3} of a liquid and a prism side of 4 mm. For solids the minimum volume must be of a convenient shape. There is a certain advantage for the interference method. R. S. R.

2021. Metallic Dispersion in the Near Infra-Red. C. Hurst. *Roy. Soc., Proc.* 144. *pp.* 377–381, *March* 29, 1934.—It is shown that the equations for the index of refraction and the coefficient of absorption of a metal in the near infra-red, which have been developed by Kronig on a quantum-mechanical basis, are formally identical with the dispersion equations obtained by Drude [see Abstract 1833 (1900)] by classical methods. The close analogy between the underlying assumptions of the two derivations is indicated. AUTHOR.

2022. Method of Computing Projecting Mirrors of Thick Glass. G. Cahen. *Comptes Rendus,* 198. *pp.* 1148–1149, *March* 19, 1934.—A theorem is given by which the equation (in parametric form) of the refracting or reflecting surface may be computed from a knowledge of the equations of the caustics; if the equations of the arcs of the caustics may be written in a form which is integrable, an expression which occurs in the theorem may be simplified. An example of the application of the theorem to the case of a thick glass paraboloidal mirror is given. H. J. H. S.

2023. Refractive Indices of Refractometer Prism. A. Karvonen. *Zeits. f. Instrumentenk,* 54. *pp.* 87–91, *March,* 1934.—It has been shown previously [see Abstract 2792 (1930)] that the refractive index (n) for the refractometer prism, if known for a few lines, can be calculated very accurately for numerous other lines with the help of the Hartmann dispersion formula. Differences between the observed and earlier known values did not exceed 1×10^{-5} and very good agreement was obtained for water. Some of the earlier values of n for water were with wave-lengths which could not be used until recently with a new type of prism, but these show good agreement. Values of n are set out in a table for the prism for three H lines and one Na line as calculated and observed and the differences do not exceed 1×10^{-5}. The values are also compared for water at 20° C. with the old and a new Pulfrich refractometer for wave-lengths from 4340 to 7065 Å and the mean difference is 4×10^{-5}, the values with the older apparatus being greater. These differences are considered to be due to errors inherent in the apparatus and the limits of accuracy of the apparatus equal those of the purity of the liquid. R. S. R.

2024. Apparatus for Very Accurate Angle Measurements. A. Berroth. *Zeits. f. Instrumentenk.* 54. *pp.* 69–76, *March,* 1934.—An apparatus called a wedge micrometer is attached to a telescope or theodolite to provide an accurate method of measuring the angle subtended between two objects in the field of view. A glass wedge is mounted to cover half the objective so that it can be rotated and tilted until coincidence between the two objects is produced. This provides a very sensitive method of measurement which can be applied to physical, surveying and astronomical purposes. The theory of the method is discussed, a calibration curve given, and the accuracy analysed. W. D. W.

See also Abstracts 1778, 1791, 2025, 2088, 2096, 2097, 2145.

SPECTROSCOPY.

2025. Zone Plate Determination of Dominant Wave-Length of Filtered Lamp Light. J. W. Ellis and B. W. Sorge. *J.O.S.A.* 24. *pp.* 103–106, *April,* 1934.—Use is made of the enormous inverse chromatic aberration of a zone plate to determine the dominant wave-length, so far as the eye is concerned, of the light from a lamp of definite colour-temperature transmitted through members of a group of gelatin filters. For representative members of the group this wave-length is compared with the centre of gravity of the luminosity curve plotted with the aid of the energy distribution of the lamp, the transmission percentages for the filters and the visibility curve for the normal eye. AUTHORS.

2026. First Spectrum of Tantalum. C. C. Kiess and E. Z. Stowell. *Bureau of Standards, J. of Research,* 12. *pp.* 459–469, *April,* 1934.—Wave-lengths of more than 2100 lines emitted by the arc in air between electrodes of tantalum metal have been measured in the spectral region from 10,300 Å in the infra-red to 2300 Å in the ultra-violet. These lines are characteristic of the spectrum emitted by neutral tantalum atoms. Many of the lines are clearly complex and present the appearance of narrow rectangles. Several lines in the ultra-violet, which have been found to originate in the lowest energy state, were observed as absorption lines in the spectrum of the underwater spark. The arc spectrum is always accompanied by an extensive band spectrum, attributable to the oxide, which consists of bands shaded toward the red from inconspicuous heads. Whenever recognised as such, these heads have been measured. AUTHORS.

2027. Optical Excitation of the Thallium Spectrum in its Halide Vapours. H. Neujmin. *Phys. Zeits. d. Sowjetunion,* 5. 2. *pp.* 344–358, 1934. *In German.*—The excitation of Tl lines by illumination of the vapours of its halides by ultra-violet radiation is investigated and interpreted as a resonance phenomenon. J. S. G. T.

2028. Arc Spectrum of Chromium under Reduced Pressure. H. Werres. *Zeits. f. wiss. Phot.* 32. *pp.* 278–282, *March,* 1934.—Examines the arc spectrum of chromium, both when burning normally in air and under very reduced pressure, between the limits 4400 and 2900 Å. The results obtained are given in tabular form and are compared with results previously obtained by King, and by Foster, the estimated intensities of the lines being shown in each case. The classification of Catalán and Sancho, the temperature class according to King, and the sun's spectrum are also given, and, from calculated and measured differences between the wave-lengths in air and under reduced pressures, the average shift of the lines to the red end of the spectrum with reduction in pressure is found to be 0·018 Å. R. C. F.

2029. Multi-Coloured Hydrogen (Bunter Wasserstoff). A. Güntherschulze. *Zeits. f. Physik,* 88. 3–4. *pp.* 273–274, *March* 19, 1934.—The author replies to Gerlach's criticism of his work on this spectrum. [See Abstract 1160 (1934).] The author contends that his results are not attributable merely to the presence of mercury vapour along with the hydrogen. J. S. G. T.

2030. Spectra of Chlorine, Cl III, Cl IV and Cl V. I. S. Bowen. *Phys. Rev.* 45. *pp.* 401–404, *March* 15, 1934.—About 200 additional lines have been classified in Cl III; 21 of these are intercombination lines. This analysis fixes most of the doublet and quartet terms arising from the addition of a 4*s*, 5*s*, 4*p*, 3*d* or 4*d* electron to either the ^3P or ^1D state of the core. Approximately 50 new lines have been classified in Cl IV and 20 in Cl V. AUTHOR.

2031. Intensities in the O II Spectrum. K. G. Emeléus. *Nat. Acad. Sci., Proc.* 20. *pp.* 115–117, *Feb.,* 1934.—Some intensity anomalies in the spectrum of O II are studied, several different sources being employed. Certain multiplets vary markedly in intensity from source to source. Various suggestions are put forward to account for the anomalies and it is emphasised that in work of this type the state and degree of dissociation of the molecules must be taken into account. A. H.

2032. Fine-Structure Analysis of $H^1\alpha$ and $H^2\alpha$. R. C. Williams and R. C. Gibbs. *Phys. Rev.* 45. *pp.* 475–479, *April* 1, 1934.—Corrections to an observed "doublet" interval to find the true interval and for relating the position of an intensity maximum to that of its components are critically discussed. The need for clearly distinguishing between the position of the centre of gravity of even a nearly symmetrical intensity complex and that of its maximum is emphasised. A Fabry-Pérot interferometer was used to examine the fine-structure of the $H^1\alpha$ and the $H^2\alpha$ lines. The interval between the main components of the "doublet" is found to be 0·308 cm.$^{-1}$ for $H^1\alpha$ and 0·321 cm.$^{-1}$ for $H^2\alpha$ as compared with 0·328 cm.$^{-1}$ indicated by theory. The relative intensities of the components as revealed by the analysis are approximately in agreement with theory. (For note on Rydberg constant for H^1 see also p. 491.) AUTHORS.

2033. Doppler Displacements in Hydrogen Canal Rays. Anna I. McPherson. *Phys. Rev.* 45. *pp.* 485–487, *April* 1, 1934.—Hydrogen canal rays of uniform energy have been obtained by accelerating the hydrogen ions formed in a low voltage arc through a short electric field. The spectrum has been observed at $H\beta$ and $H\gamma$, in the direction of motion, and the Doppler displacements of the lines H_{31}, H_{21}, H_1, from atoms accelerated as H^+_3, H_2^+, H_1^+, agree acceptably with the values of the displacements calculated from the applied potentials between 7000 and 17,000 volts. H_{31} diminishes in intensity and H_{21} and H_1 increase with decrease of pressure. H_{31} and H_{21} are equal in intensity at 0·019 mm. which is of the order of pressure expected if the numbers of H_3^+, H_2^+ are determined in the arc space. An apparent minimum velocity for excitation of radiation in the neutral hydrogen atom moving in hydrogen was observed at about 40 volts. In a helium-hydrogen mixture the hydrogen Doppler lines H_{21} and H_1 alone were perceptible, H_{31} not appearing. AUTHOR.

2034. Wave-Lengths and Spectral Laws. F. Paschen. *Preuss. Akad. Wiss. Berlin, Ber.* 30. *pp.* 876–885, 1933.—The quantity occurring in spectral laws is wave-number, *i.e.*, the reciprocal of the wave-length. The paper is concerned with the errors introduced when differences of frequency or wave-number are in question. It is pointed out that grating spectra in the red and infra-red are particularly adapted for the solution of problems of fine structure and, from a knowledge of spectral laws, the determination of ultra-violet wave-lengths. The spectra of Al I and Al II investigated by Paschen and Ritschl in the infra-red are considered in this connection. F. S.

2035. Vector Model for Almost Enclosed Shells. M. H. Johnson, Jr. *Nat. Acad. Sci., Proc.* 20. *pp.* 117–120, *Feb.*, 1934.—An analysis is made of how the properties of a group of equivalent electrons may be formulated in terms of the corresponding holes, and to what extent vector model considerations are applicable to holes. In the examples considered the results of the computations on the above basis agree with previous results. A. H.

2036. Dirac Vector Model in Complex Spectra. J. H. van Vleck. *Phys. Rev.* 45. *pp.* 405–419, *March* 15, 1934.—Dirac has shown that the secular problem presented by the permutation degeneracy is formally equivalent to a problem in vector coupling for which the Hamiltonian function is $-\frac{1}{2}\Sigma K_{ij}(1+4\mathbf{s}_i\cdot\mathbf{s}_j)$ where $\mathbf{s}_i$, $\mathbf{s}_j$ are respectively the spin vectors of orbits i, j and K_{ij} is the exchange integral which connects i and j. The vector model can be used in place of Slater's determinantal wave functions to calculate atomic spectral terms, provided much of Slater's powerful method of diagonal sums is retained. The configuration d^3 is treated as an example. Configurations of the form sa^k $(a=p, d, f\cdot\cdot\cdot;\ 0<k<4l_a+2)$ are particularly amenable to the vector model, as it enables the energy of sa^k to be written down immediately if that of a^k is known. It is thus found that the two states $S=S_k\pm\frac{1}{2}$ built upon a given configuration S_k, L_k of the core a^k should have a separation proportional to $S_k+\frac{1}{2}$ and independent of L_k. Experimentally, this prediction is confirmed only roughly, like the interval relations found by Slater, because perturbations by other configurations are neglected. Various applications to molecular spectra are given. The Heitler-Rumer theory of valence, which neglects directional effects, has a particularly simple interpretation in terms of the vector model. In configurations of the form p^n both spin-orbit and electrostatic energy can be calculated by the vector model without use of the invariance of diagonal sums. For this particular configuration the Pauli principle is equivalent to a constant $2\mathbf{s}_i\cdot\mathbf{s}_j=-(\mathbf{l}_i\cdot\mathbf{l}_j)^2-(\mathbf{l}_i\cdot\mathbf{l}_j)+\frac{1}{2}$ connecting the relative orientations of spin and of angular momentum vectors. [See following Abstract.] AUTHOR.

2037. Extension of the Dirac Vector Model to Include Several Configurations. R. Serber. *Phys. Rev.* 45. *pp.* 461–467, *April* 1, 1934.—The vector model for the electrostatic interactions of a system of n electrons, as originally given by Dirac and as used by J. H. van Vleck [see preceding Abstract] suffers from the restriction that it allows the energy matrix to be set up completely only for a single spatial configuration. In the present paper this restriction is removed. It is shown how the complete energy matrix may be found by means of the vector model, whatever the number of configurations involved. An an example of the method, the energies of the two ^2D states arising from the atomic configuration d^3 are calculated. Calculations by this method are simpler than the corresponding calculations using Slater wave functions in that the energy matrix factors according to characteristic values of S. AUTHOR.

2038. Ultra-Violet Bands of H^1H^2. C. R. Jeppesen. *Phys. Rev.* 45. *pp.* 480–484, *April* 1, 1934.—By using a 2 m. grazing incidence vacuum spectrograph, the extreme ultra-violet emission spectrum of a mixture of about 60 % H^1 and 40 % H^2 has been photographed. Altogether twelve bands have been identified as belonging to the $2p^1\Pi_{cd}-1s^1\Sigma$ system of the H^1H^2 molecule. Analysis of these bands indicates that the rotational and vibrational constants for the H^1H^2 molecule are the same to within experimental error as those derived from the theory of the isotope effect. There is, however, an extremely large electronic isotope shift of 135 cm.$^{-1}$ units. The apparent vibrational perturbation found previously in the $v=3$ level of the $2p^1\Pi_{cd}$ state of the H^1H^1 molecule has its counterpart in the same level of the H^1H^2 molecule where its magnitude is about 4·3 cm.$^{-1}$ units, compared to 10·4 cm.$^{-1}$ for H^1H^1. AUTHOR.

2039. Infra-Red Absorption Spectra of Cyclic and Acyclic Organic Compounds. R. Freymann and A. Naherniac. *J. de Physique et le Radium*, 5. *pp.* 75–84, *Feb.*, 1934.—A detailed description of a self-registering spectrometer for the wave-length region of $0{\cdot}8-1{\cdot}20\mu$ is given. This spectrometer has high resolving power. Benzene has been examined. Bands are found at $0 \cdot 87$ and $1 \cdot 14\mu$, which are attributed to the CH= linking; the bands at $1 \cdot 09$ and $1 \cdot 11\mu$ are assigned to the C=C linking, and a very complicated band at about $1 \cdot 0\mu$ is due to the C-H linking. Iodobenzene, bromobenzene, chlorobenzene, nitrobenzene, toluene, anisole and benzyl alcohol have also been investigated. It has been observed that there is a displacement of the position of the benzene bands towards shorter wave-length in substituted derivatives and that this displacement increases the higher the electric moment of the substitution product. A number of acyclic compounds have been examined, with a view to obtaining fuller information about the band at $1 \cdot 0\mu$. Various theories about the assignment of these bands are discussed.

W. R. A.

2040. Optical Absorption Constants of Alkali Halide Crystals in the Region of the Ultra-Violet Characteristic Frequencies. G. Bauer. *Ann. d. Physik,* 19. 4. *pp.* 434–464, *Feb.*, 1934.—In regions of metallic absorption, where the absorption coefficient is of the order of 10^5 mm.$^{-1}$, films of thickness of the order of mμ must be employed, and these are best prepared by condensing the vapour on a plate of transparent substance *in vacuo.* The thickness of the film can be determined most accurately by optical methods. The Wiener method is shown to be unsuitable, and is replaced by a simple arrangement in which Newton's rings are measured in reflected light. The films are liable to be porous, when the inhomogeneity complicates measurements of thickness and also gives rise to low values for the absorption constants. It can be removed to a large extent by a thermal treatment of the films which is described. The effect of interference in the films on the validity of Beer's law in the region of absorption is investigated, and the deviation from exponential absorption is calculated. The following values are obtained for the absolute absorption coefficients for the first ultra -violet band—

	NaBr	KBr	KI	$PbCl_2$
λ(Å)	1915	1885	2200	2708
k(mm.$^{-1}$)	97,400	90,400	71,800	71,000

An empirical relationship between these results and the lattice constants is investigated.

C. B. A.

2041. Absorption of Light by Adsorbed Bromine. J. F. H. Custers and J. H. de Boer. *Physica,* 1. *pp.* 265–270, *Feb.*, 1934. *In German.*—The absorption of light by bromine adsorbed on CaF_2 at very low relative pressures is measured. The layers under these conditions are almost colourless, and the absorption spectrum lies in the ultra-violet, consisting of two bands with maxima at 2670 and 2520 Å. As in the case of adsorbed iodine, the energy separation of these maxima depends on the difference in the energies of the $^2P_{3/2}$ and $^2P_{1/2}$ states of the halogen atom. The violet displacement of the absorption spectrum is, as in the case of iodine, $1 \cdot 9$ volts.

C. B. A.

2042. Ultra-Violet Absorption Spectra of Aromatic Substances. Part II. A. Hillmer and P. Schorning. *Zeits. f. phys. Chem.* 168. *Abt. A,* 2–3. *pp.* 81–106, 1934.—The changes which occur in the ultra-violet absorption spectra when various side-chains are introduced into benzene, phenol, dihydroxybenzene and their methyl and methylene ethers, are investigated. The side-chains are either saturated (n-propyl) or contain a double bond, a CO, OH, or –O– radical, or more than one of these, at various distances from the nucleus. Solvent influences are also studied.

V. 19

Absorption curves for many of the derivatives are reproduced. [For Part I see Abstract 1177 (1934).] C. B. A.

2043. Absorption of Organic Compounds in the Schumann Region. G. Scheibe and H. Grieneisen. *Zeits. f. phys. Chem.* 25. *Abt.B.* 1–2. *pp.* 52–56, 1934. — Ethane, ethylene, cyclohexane, cyclohexanone, cyclo-pentanone, cyclopentadiene, butadiene, pyrrol, dimethyl-ether and di-ethyl-ether were investigated in the Schumann region using a small fluorite vacuum spectrograph. The same frequency difference of 1200 cm.$^{-1}$ was found as for acetone, acetaldehyde and methyl iodide. According to Herzberg and Teller, this is due to the $-CH_2$ group. Ethane and cyclohexane have a quite different band structure perhaps attributable to the $-CH_3$ group. Other possibilities are discussed. F. S.

2044. Absorption Spectra of Some Carbon Compounds in the Schumann Region. E. P. Carr and H. Stücklen. *Zeits. f. phys. Chem.* 25. *Abt.B.* 1–2. *pp.* 57–70, 1934.—A fluorite vacuum spectrograph was used, the saturated compounds hexane and heptane being investigated, as well as unsaturated hydrocarbons and aromatic compounds. All substances were vaporised. Six hydrocarbons showed a wide dissociation band below 1530 Å and four unsaturated ones an additional band at 1740 Å. The first band is missing in the case of benzene, while the second is displaced to the red and broken up into a number of double bands between 1720 Å and 1800 Å. F. S.

2045. Absorption of Substituted Benzols. Part IV. Halogen Toluols and Relations between Band Displacement and Dipole Moment. H. Conrad-Billroth. *Zeits. f. phys. Chem.* 25. *Abt.*B. 1–2. *pp.* 139–150, 1934.—The ultra-violet absorption spectra of halogen benzols and halogen toluols are recorded and are discussed along with other data with reference to the calculating rule given in a previous paper [see Abstract 2425 (1933)]. A quantitative connection between dipole moment and displacement of the mono-derivatives is given. J. E. K.

2046. Absorption of Long Columns of Liquid Oxygen. R. Guillien. *Comptes Rendus,* 198. *pp.* 1223–1225, *March* 26, 1934.—The absorption of liquid oxygen in thicknesses up to 109 cm. has been studied between 3500 and 8400 Å. A new band of low intensity between 7295 and 7320 Å, with a maximum at 7307 Å, has been discovered, and the band at 4620 Å was also observed. Several bands between 5800 and 5350 Å recorded by Ellis and Kneser could not be detected at any thicknesses between 0·5 and 109 cm., and they are assumed not to exist. The bands are dissymmetric and fall off more quickly on the side of longer wave-lengths. The wave numbers of the maxima form arithmetical progressions with the same separation 1417 cm.$^{-1}$, which is less than that obtained in the Raman effect. They can be represented by an approximate formula. The bands can be classified into systems and can all be interpreted on the basis of the existence of $^3\Sigma$, $^1\Delta$, $^1\Sigma$, $2^1\Delta$, $2^1\Sigma$, $^1\Delta + {}^1\Sigma$ states and the vibration term 1417 cm.$^{-1}$. C. B. A.

2047. Absorption Spectrum of Chromyl Chloride. M. Kantzer. *Comptes Rendus,* 198. *pp.* 1226–1227, *March* 26, 1934.—The absorption spectrum of chromyl chloride is studied at wave-lengths remote from the region of photochemical decomposition. The spectrum is composed of wide lines, some of which exhibit a certain badly defined fine structure. The known lines are remeasured down to 5428 Å, and further principal maxima down to 5016 Å are recorded. The lines are classified into three categories according to their behaviour under temperature variation. One of these series is almost independent of temperature and pressure and can be represented by an empirical formula of the Deslandres type. It is assumed to represent the normal state of the molecule. The intensities of the other series are affected reversibly by temperature, but the positions of the lines remain unchanged. C. B. A.

2048. $^1\Pi \rightarrow {}^1\Delta$ Band of NH and the corresponding ND Band. G. H. Dieke and R. W. Blue. *Phys. Rev.* 45. *pp.* 395–400, *March* 15, 1934.—A $^1\Pi \rightarrow {}^1\Delta$ band of NH at 3240 Å is compared with the corresponding ND (*i.e.*, NH^2) band at 3235 Å. The rotational constants of the two bands are related within the limits of experimental errors in the way expected theoretically. It is necessary to take into account that the lowest vibrational state has half a quantum of vibrational energy. The existence of zero-point vibrational energy appears also in the fact that the zero lines of the two bands are separated by 93·39 wave numbers. In agreement with the theoretical expectations the Λ-doubling in the ND band is smaller than in the NH band by a factor 3·511. AUTHORS.

2049. Intensity-Distributions in Second Positive Band System of N_2. N. R. Tawde. *Phys. Soc., Proc.* 46. *pp.* 324–332, *May* 1, 1934.—Intensities of bands in the $C^3\Pi \rightarrow B^3\Pi$ system of N_2 under four different conditions of excitation have been measured by means of calibrated photographs of the spectrum; transition probabilities derived from these have been compared with the Condon parabola as obtained from the potential-energy functions of Morse and Rydberg; effective temperatures have been derived on the assumption of a Boltzmann distribution for vibrational energy; and an attempt has been made to explain the variation of intensities and transition probabilities under some of the conditions studied. [See Abstract 5002 (1932).] AUTHOR.

2050. Nuclear Spin of Sodium. J. Joffe. *Phys. Rev.* 45. *pp.* 468–474, *April* 1, 1934.—The alternation of intensities in absorption in the band spectrum of sodium was investigated for the purpose of determining the spin of the sodium nucleus. Measurements were confined to the (0,2) band in the $^1\Pi \leftarrow {}^1\Sigma$ transition, which alone is reasonably free from overlapping bands. Relative absorption coefficients for the Q branch lines, with $J = 48$ to $J = 73$ inclusive, were calculated. These yielded an average value for the alternation of intensities of 1·71, the average being obtained from 5 different plates. These results agree best with the theoretical alternation ratio of 1·67 corresponding to a nuclear spin of 3/2. AUTHOR.

2051. Continuous Spectrum of Hydrogen. D. Chalonge. *Ann. de Physique,* 1. *pp.* 123–214, *Feb.*, 1934.—A photometric study is made of the continuous spectrum of hydrogen under various conditions of excitation. The continuous nature of both the atomic and molecular continua is clearly established, and the continua are shown to be easily differentiated. In the atomic case two continua are observed, connected with the Balmer and Paschen series respectively, and the intensity of both of these changes very slowly with the wave-length. The data obtained for the molecular continuum are discussed in the light of the theory of Winans and Stueckelberg. The results of Yu on the continuous absorption of stars of type A and B are confirmed and the emission of the hydrogen atomic continuous spectrum is detected in the case of two stars. A. H.

2052. Absorption and Fluorescence Spectra of Fabreine. M. Fontaine. *Comptes Rendus,* 198. *pp.* 1077–1079, *March* 12, 1934.—The absorption and fluorescence of solutions in pyridine under ultra-violet excitation has been studied. In absorption, two sharp bands are observed

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with maxima at 612 μμ and 566 μμ. The fluorescence spectrum extends from 612 μμ to 674 μμ, consisting of two bands with maxima at 666 μμ and 618 μμ—corresponding, no doubt, to the two absorption bands. Reproduction of the spectra are given. J. E.

2053. Anomalous Zeeman Effect in Individual Hyperfine Structure Components of the Mercury Resonance Line 2537 Å. Part I. π-Components. A. Zvironas. *Helv. Phys. Acta,* 7. 2. *pp.* 224–256, 1934. *In German.*—The Zeeman effect in individual h.f.s. components of the Hg resonance line 2537 Å in absorption has been investigated by a combination of Mrozowski's filtration method and the Malinowski-Schein resonance curve method, employing an amplifier for the small photoelectric currents. The results lead to the conclusion that in a field of 5850 gauss, a short-wave π-Zeeman component of the h.f.s. line $-8{\cdot}5$ (line *b* of Hg^{201}) wanders over the h.f.s. line $-25{\cdot}4$ (line *c* of Hg^{201} and B of Hg^{199}) which is in accordance with the calculations made by Inglis on the basis of the Schüler-Keyston structure for the 2537 line. The theoretical π-separation for lines B of Hg^{199} and *c* of Hg^{201}, which belong to the h.f.s. line $-25{\cdot}4$, agrees well with experiment up to 3500 gauss. The agreement is still better if it is assumed that line B is displaced by $1{\cdot}3 \times 10^{-3}$ Å to the long wave-length side of *c*. So far as could be observed, the experimental results confirm the structure suggested by Schüler and Keyston for the 2537 line. The results are compared with those of MacNair and of Mrozowski, and with those predicted theoretically. C. B. A.

2054. Rotational Raman Effect in Liquids. S. Bhagavantam. *Indian Journ. Phys.* 8. *pp.* 197–207, *Dec.* 15, 1933.—The rotational spectra of a few liquids such as benzene, formic acid, and molten salol have been investigated at different temperatures. The intensity distribution in the rotational wing for benzene is examined in the light of the various theories available, and the conclusion drawn that none of them are satisfactory, without the auxiliary supposition that the liquid state may be regarded as a mixture of solid and gaseous molecules. Pauling's criteria for the rotation of molecules in solids are applied, and it is concluded that liquids may be divided into two types, (1) Liquids such as H_2, HCl, O_2, N_2, for which the intensity distribution in the wings follows the gas laws, (2) Liquids like benzene, for which the gas laws will *not* predict the intensity distribution in the rotational wings. The patterns are more complex, and are to be attributed to internal oscillations in the liquid similar to those that exist in a solid. A. C. M.

2055. Raman Frequencies of NH_4^+. I. R. and C. S. Rao. *Zeits. f. Physik,* 88. 1–2. *pp.* 127–134, *Feb.* 21, 1934.—The Raman spectra of ammonium chloride, nitrate and sulphate were photographed in solutions, and of the chloride and nitrate as crystals. The positions of the lines were read from the microphotometer curves, as on account of their diffuseness their positions were difficult to judge directly. The mean values of the positions of the frequencies are in solution 3157 and 3221 cm.$^{-1}$, and in crystals 3117 and 3220 cm.$^{-1}$. The results are compared with the frequencies for CH_4 and NH_3, and conclusions drawn on the basis of a pyramidal model with N at the vertex. A. C. M.

2056. Raman Spectrum of Heavy Water. R. W. Wood. *Phys. Rev.* 45. *pp.* 392–394, *March* 15, 1934.—The Raman spectra of two samples of heavy water, one 18 % and the other 80 %, were excited by the 2536 line of mercury. The 18 % heavy water gave the usual band ($\Delta\nu = 3445$)

and a new band ($\Delta\nu = 2623$). The new band is probably due to the molecule H^2OH^1. With 80% heavy water the new band was much stronger than the 3445 band, but was shifted slightly towards shorter wave-lengths. With the 80 % sample the 3445 band was shifted slightly toward the red with respect to ordinary water. From the amount of shift it is concluded that molecules containing only one atom of heavy hydrogen give two bands, $\Delta\nu = 2623$ and $\Delta\nu = 3500$, while the molecules made of two heavy hydrogen atoms give a single band $\Delta\nu = 2517$. These bands have been photographed as lines in the case of heavy water vapour. AUTHOR.

2057. Raman Effect and Molecular Structure. K. W. F. Kohlrausch. *Naturwiss.* 22. *pp.* 161–169, *March* 16; 181–189, *March* 23, *and pp.* 196–204, *March* 30, 1934.—This is a general article, in four parts, upon the application of Raman effect data to problems of molecular structure. The first and second parts deal with the empirical interpretation of Raman spectra and include, together with other examples, discussion of the evidence obtainable in this way upon the questions of the structure of benzene and of the "free rotation" about a single bond. In the third part a short account is given of the relationship of Raman effect and molecular symmetry, reference being made to the polarisability theory, and the rules of selection and polarisation. Lastly comes a brief discussion of the information obtainable from the observed frequencies of Raman lines as to the nature and magnitude of the forces acting in molecules. Important literature references are appended. L. A. W.

2058. Molecular Scattering of Light in Liquids. Orientation Fluctuations of Homopolar and Heteropolar Molecules. A. Rousset. *Comptes Rendus,* 198. *pp.* 1227–1229, *March* 26, 1934.—The unpolarised background observed on either side of the exciting line in light scattered by heteropolar liquids is much weaker than is predicted by the theory of Raman rotation lines [see Abstract 158 (1934)]. This result can be explained on the assumption that the heteropolar molecules execute small oscillations on either side of the orientations corresponding to minimum potential energy of the collection of doublets. The intensity of the continuous background then depends not only on the molecular anisotropy, but also on the amplitude of these oscillations, and this is smaller the larger the permanent electric moment of the molecules. The theory also provides an explanation of the observation that the Q-branch in the spectra of homopolar liquids is continuous, whereas in those of heteropolar liquids it consists of fine lines. C. B. A.

2059. High-Intensity Monochromator. H. R. Schulz. *Zeits. f. Physik,* 88. 3–4. *pp.* 270–272, *March* 19, 1934.—In this monochromator the object glass is a triplet of aperture f/1 and diameter 10 cm.; two Rutherford prisms are used; and the slit height is 12 mm. The components of the triplet and its aberrations are given. Lines $1 m\mu$ apart can be separated even at the long wave end of the spectrum. D. H. F.

2060. Ultra-Violet Monochromators for Large Area Illumination. G. R. Harrison. *Rev. Sci. Instruments,* 5. *pp.* 149–152, *April,* 1934.—Several types of large ultra-violet monochromatic illuminator are described, in which water or other transparent liquid is used as the dispersing medium. The most readily made consists merely of a spherical concave mirror immersed in a basin of distilled water at an angle of about 30° from the horizontal; this acts as a crude prism somewhat on the principle of the Féry quartz prism, and gives monochromatic though distorted images of a high power horizontal mercury arc used as a source.

By placing an exit slit of suitable shape in the focal plane these images can be isolated one at a time, giving surprisingly pure monochromatic radiation. Such an instrument of large size can be constructed at small expense and should be useful for many types of biophysical and photochemical work. A somewhat more expensive but more distortion-free instrument can be made by using a plane mirror under water with one or two large lenses of fused quartz. The horizontal position of the input face of the water prism greatly reduces convection currents, and renders large sheets of expensive optical material unnecessary. Instruments of both types with aluminum, chromium and platinum-coated glass mirrors over eight inches in diameter have been constructed and found to operate satisfactorily. Typical spectrum photographs taken with one of the concave mirror instruments show the degree of spectrum resolution obtained. AUTHOR.

2061. Pressure Shift of Iron Lines. E. Beglinger. *Helv. Phys. Acta*, 7. 2. *pp.* 149–169, 1934. *In German.*—Ocular measurements with a microscope and also a Moll microphotometer were used, the probable error being less with the latter. Seven lines of one multiplet showed a decrease of shift from 0·0052 Å to 0·0020 Å per atmosphere with increasing wavelength, while for another multiplet shifts of 0·0088 Å to 0·0030 Å were found. For three strong spark lines the shift was found to be about three times as great as for the arc. F. S.

2062. Influence of Pressure upon Flame Spectra. W. A. Bone and F. G. Lamont. *Roy. Soc., Proc.* 144. *pp.* 250–256, *March* 29, 1934.—A new apparatus is described for maintaining continuous flames in air or oxygen at high pressures, hydrogen, carbonic oxide and mixtures of these having been studied up to 100 atmospheres. With CO, the CO–O_2 bands were obliterated and the 3064 HO band faded out as the pressure increased, showing the CO oxidation was increasingly direct. With H_2, the HO bands were strengthened and the 3064 band head reversed. Degrading of the bands was not so rapid, showing a shift of energy from the head as the pressure increased. With CO–H_2 mixtures, the HO bands were fainter and the CO continuous spectrum more pronounced, showing that the Weston effect is counteracted by increasing pressure. F. S.

See also Abstracts 1850, 1996, 2006, 2073, 2074, 2113, 2171.

VELOCITY OF LIGHT.

2063. Velocity of Stellar Light. P. Salet. *Comptes Rendus*, 198. *pp.* 904–905, *March* 5, 1934.—The earth's orbital velocity being known, and the Doppler displacement of a star measured, the velocity of the light from the star can be computed. This practically reverses the usual procedure for allowing for the earth's motion. The author finds the resulting velocity of light greater than Michelson's value for all spectral types, by as much as 1 %. He considers but dismisses the possible effect of instrumental errors; and correlates the result with variations in the aberration constant, also depending on spectrum type. T. L. M.

VISION.

2064. Acuity of Vision as a Function of Brightness. M. Kruyswijk and C. Zwikker. *Physica*, 1. *pp.* 225–234, *Feb.*, 1934. *In English.*—A series of twelve simple geometric solids (cube, tetrahedron, truncated cylinder, etc.) were used as test objects to determine the visual acuity at

brightness levels ranging from about 0·5 to 100 candles/sq. m. for white light and monochromatic sodium light. The criterion employed was recognition of the form of the test object, and the measured quantity was the maximum distance at which this could be done. The results obtained were of the same general character whatever the angles of illumination and view, and whether the objects were seen against a bright or dark background. The visual acuity steadily increased with brightness in the range studied, sodium light giving a 30 to 40 % higher acuity than white light over most of the range, the values tending to converge at about 100 c./sq.m.
W. S. S.

2065. Glare in Yellow Light. Y. le Grand. *Comptes Rendus*, 198. *pp.* 1075–1077, *March* 12, 1934.—Measurements were made of the brightness-difference threshold for a 3° bipartite test field at brightnesses (white light) ranging from 10^{-6} to 10^{-2} cp./cm.^{2}. On placing a white glare source 5° to the side of the test field, the brightness-difference threshold was decreased, throughout the range. This decrease was somewhat less if a yellow filter (transmission greater than 0·90 for $\lambda > 0\cdot55\mu$, less than 0·10 for $\lambda < 0\cdot50\mu$) was inserted at the glare source. If, however, the yellow filter was placed at the observer's eye, so that both test field and glare source appeared yellow, the brightness-difference threshold divided by the test-field brightness (*i.e.*, the Fechner fraction) was found to have the same value as with the yellow filter removed. It is concluded that the use of yellows filters on motor-car headlights produces no advantage from the point of view of reduction of glare. W. S. S.

2066. Ives' Theory of Flicker. P. W. Cobb. *J.O.S.A.* 24. *pp.* 91–98, *March*, 1934.—The author criticises Ives' theory of critical flicker frequency which is based on the notion of diffusion of the product of the photochemical reaction concerned in vision, from its place of formation to the place where it sets up a nervous impulse, on the ground that the effects of change in the stimulus cycle are not correctly reproduced. It is argued that, to account for the relation between stimulus amplitude and critical flicker frequency, the diffusion hypothesis would require an incredibly inefficient retinal mechanism. The relation between average stimulus intensity and critical frequency (Ferry-Porter law) remains an empirical law. A method of avoiding complications due to this law, in investigating other phases of flicker, is suggested. W. S. S.

2067. Dependence of Flicker on the Dark-Light Ratio of the Stimulus-Cycle. P. W. Cobb. *J.O.S.A.* 24. *pp.* 107–113, *April*, 1934. —Measurements were made of the critical flicker frequency for an abruptly interrupted stimulus in which the ratio ϕ of light phase to cycle time varied from 0·0673 to 0·982. In changing from one dark-light ratio to another, the average stimulus intensity for the whole cycle was kept constant to eliminate intensity effect. The cases studied were: 25 millilambert average field brightness, dark surround or 25 ml. surround, and 5 ml. average field brightness, 25 ml. surround. The critical frequency was highest when test field and surround had the same brightness. The critical flicker frequency decreases to about one half as the ratio ϕ increases over the range mentioned. The results are discussed in the light of Ives' theory of flicker and it is shown that the explanation of flicker effects, by the resolution of the stimulus-cycle into sinusoidal components, leads to difficulties. W. S. S.

X-RAYS.

2068. X-Ray Scattering by Carbon. P. C. Mukherjee. *Zeits. f. Physik,* 88. 3–4. *pp.* 247–250, *March* 19, 1934.—Examination of the scattering diagrams for carbon from benzol, camphor, animal charcoal, coke and gas carbon. Besides the known refraction-rings at 24°, 40′ and 42°, the intensity of which increases with the substance in the order stated, the central scattering was also investigated before and after heating to 600°. There is a difference between the grating constant for graphite and that for the above forms of amorphous carbon, which points either to a difference in the chemical structure or, if amorphous carbon is built up of small graphitic crystals as is usually believed, to a difference in the spacing of these crystals. A. D.

2069. Klein-Nishina Formula for X-Ray Scattering. J. Read and C. C. Lauritsen. *Phys. Rev.* 45. *pp.* 433–436, *April* 1, 1934.—An X-ray tube and a spectrograph were used to produce monochromatic beams of wave-length from 50 to 20 X. The absorption coefficient per electron for each beam was measured in carbon and aluminium. Results indicate that it is unlikely that the Klein-Nishina formula for the scattering coefficient per electron is in error by more than 1 % in this region of wave-lengths. AUTHORS.

2070. Probability of Double Ionisation in the X-Ray Region. F. Wisshak. *Phys. Zeits.* 35. *pp.* 301–302, *April* 1, 1934.—The intensity of non-diagram lines is considered to be a measure of the occurrence of multiple ionisation. The author therefore compares the sum of the intensities of the satellites of Cu $K\alpha_3$ and $K\alpha_4$ with the sum of the intensities of the main lines $K\alpha_1$ and $K\alpha_2$. An ionisation spectrometer with a double crystal was used. The excitation voltage ranged from 27 kV to 48 kV. Throughout this range the ratio of the sum of the intensities of the two main lines to that of the two satellites is 180 ± 50. Taking the author's previously obtained value of $3 \cdot 5 \times 10^{-3}$ for the probability of single ionisation of the K-shell a value of 2×10^{-5} for the probability of double ionisation is obtained. J. E. R. C.

2071. Reflection of X-Rays. J. A. Barasoain and R. Salvia. *Soc. Española de Fis y Quimica,* 32. *No.* 73. *pp.* 53–64, 1934.—A comparison is made of photometric with photographic and ionisation methods. Modifications are made in the Bragg ionisation spectrometer, some of these directed to obtain a uniform movement of rotation. In the case of a diverging beam the reflecting power is $\rho(\phi a Q/2\mu)(r+1/2\mu)$. The relation between the reflecting powers of the planes of the same crystal is exactly alike whether a divergent or a convergent beam is used, and when compared in various crystals the difference is practically negligible. The best measurements are obtained on keeping the ionisation chamber in a fixed position and giving the crystal a continuous rotation, the method of moving chamber being advisable only to locate the positions of the reflections. In the photographic method, the darkenings are proportional to the energies up to $S = 0 \cdot 9$ if the development be in 6 min. The best working conditions were experimentally ascertained. The greatest accuracy was obtained when all the lines were darkened with nearly the same intensities, by sweeping a number of times for each of the less intense lines. Working under these conditions, the results were the same for the two methods.

A. D.

2072. Widths of X-Ray Lines from Alloy Targets. L. G. Parratt. *Phys. Rev.* 45. *pp.* 364–369, *March* 15, 1934.—The widths of the $K\alpha$ X-ray lines have been found to depend upon the physical or chemical state of the target. Several alloys of Ni, Fe, Mn, Cr and Ti have been used. The widths of the lines of element A when alloyed with element B may be increased or decreased, depending on element B. Targets of Mn-Ni show an approximately linear increase in the width of $K\alpha_1$ with relative increase of Ni, reaching, at 50–50 atomic concentration, a maximum width of 23 % greater than the width from pure Mn, then, with further addition of Ni, an approximately linear decrease with the same slope as before. In general the width of $K\alpha_1$ is more susceptible than of $K\alpha_2$ to changes in the atomic environment but the ratio of peak intensities varies in a compensating manner to allow the ratio of integrated intensities of α_1 to α_2 to remain constant, 2 to 1, within the estimated error of ± 4 %. All the lines are asymmetrical. AUTHOR.

2073. Characteristic X-Rays from Metals in the Extreme Ultra-Violet. H. M. O'Bryan and H. W. B. Skinner. *Phys. Rev.* 45. *pp.* 370–378, *March* 15, 1934.—A description is given of soft X-ray bands in region 50–500 Å from Li, Be, C, Na, Mg, Al, Si and Ba targets. A 2-m. grazing-incidence spectrograph was used. The bands (except those for Ba) correspond to transitions of outer (or conduction) electrons into a vacant K- or L-shell. The diffuseness of the bands is associated with the energy spread of the filled conduction electron levels. The Ba band is an $O \rightarrow N$ transition. The other metal bands extend over a fairly wide wave-length region and each has a sharp short wave-length edge which corresponds to the sharp " surface " of the filled conduction electron levels. The bands of C and Si have a more diffuse head which is connected with their semi-conducting property. The energy spread of the metal bands may be calculated approximately from the Sommerfeld theory of metals; this provides a method of determining uniquely the number of conduction-electrons per atom in a metal. But the explanation of the precise shapes of the bands will require a more detailed theory and in particular an investigation of the transition probability of a conduction electron into a K- or L-shell. Some discussion is added on the absolute energies involved in the transitions which give rise to the bands. [See following Abstract.] AUTHORS.

2074. Theory of the Form of the X-Ray Emission Bands of Metals. H. Jones, N. F. Mott and H. W. B. Skinner. *Phys. Rev.* 45. *pp.* 379–384, *March* 15, 1934.—It is shown that the optical transition probabilities for transitions from the conduction levels in metals to the K- and L-levels may vary strongly within the lowest allowed zone, and will also depend on the azimuthal quantum number of the final state. An explanation is given of the form of the X-ray emission bands observed by O'Bryan and Skinner for Li, Be, Mg, Al. [see preceding Abstract]. AUTHORS.

2075. Faint Lines in the L Spectrum of Elements 73 Ta to 90 Th. Part I. S. Kaufman. *Phys. Rev.* 45. *pp.* 385–388, *March* 15, 1934.—Numerous weak L lines in the X-ray spectra of the heavier elements are reported. The majority are diagram lines attributable to quadripole radiations. The non-diagram lines are satellites of $L\beta_2$. Measurements were made with a modified Siegbahn-Thoraeus high-vacuum spectrometer having a dispersion, with calcite in first order and at $\lambda = 1080$ X., of 4·5 X./mm. AUTHOR.

2076. Probability of Double Jumps in X-Ray Spectra. E. G. Ramberg. *Phys. Rev.* 45. *pp.* 389–391, *March* 15, 1934.—By a suitable perturbation method, two-electron transition probabilities are computed for a number of double jumps, such as $2p, 4s \rightarrow 1s, 3s$ and $2p, 3d \rightarrow 1s, 3s$, in Na and Cu atoms. It is found that these probabilities are too small to account for the observed intensities of the X-ray satellites $K\alpha_{3,4}$. As a more general argument against the correctness of the double-jump hypothesis for the origin of the short wave-length X-ray satellites it is pointed out that the line structure due to two-electron transitions of the kind considered would consist of a symmetrical grouping of faint lines about the parent line, the stronger components being on the long wave-length side. AUTHOR.

2077. Weak Lines in the Kβ-Spectra of Mo, Rh, and Ag. H. Hulubei and (Miss) Y. Cauchois. *Comptes Rendus*, 198. *pp.* 1222–1223, *March* 26, 1934.—The Kβ-spectra of elements 42, 45, and 47 are restudied. Two new spark lines, β_8 and β_9, between β_2 and β_5, are measured for the first time. A weak line β_0, previously detected in Mo and Rh, is now observed in Ag. β_6 is observed and measured in the spectra of Rh and Ag. β_8 is wide, and may contain fine structure. On long exposure, β_4 ($KN_{IV\text{-}V}$) broadens and its centre is displaced towards shorter wave-lengths. Observation of these weak lines is facilitated by the use of filters to remove continuous background from other orders. [See also Abstract 3648 (1933).] C. B. A.

2078. X-Ray Absorption Spectra and Chemical Constitution. O. Stelling. *Zeits. f. phys. Chem.* 24. *Abt.B.* 4. *pp.* 282–292, 1934.—Investigations of the X-ray absorption spectra of chlorine in some complex compounds with di-, tri-, and tetra-valent metals are described, and the linkage relationships discussed. Typical photometer curves are included. It is found that $MnCl_2$ can add four molecules of, for example, thiourea, without the Cl-atom being displaced into the second sphere. The addition compounds of $ZnCl_2$ give only one absorption line which, however, may consist of two lines very near together. $SbCl_3$ and $BiCl_3$ give double lines which are not due to ionic compounds. $ZrCl_4$ gives two lines and the so-called chlorosalts of $ZrCl_4$ and $CeCl_4$: $(Pyr\ H)_2\ ZrCl_6$ and $(Pyr\ H)_2\ CeCl_6$ give not two but three lines, and this phenomenon has not yet been explained. H. H. Ho.

2079. X-Ray Ionoquantimeter. E. Hasché. *E.T.Z.* 54. *pp.* 267–269, *March* 15, 1934.—A further description of a mains-operated valve electrometer [see Abstract 1632 (1934)] suitable to detect the presence of small quantities of radiation from X-rays, radium, etc. In the present paper the factors which affect the sensitivity are dealt with in more detail. B. J. L.

2080. Standard Absorption Curves for Specifying the Quality of X-Radiation. L. S. Taylor and G. Singer. *Bureau of Standards, J. of Research*, 12. *pp.* 401–420, *April*, 1934.—In the measurement of X-rays there is a proportionality between the energy in the beam and its strength in röntgens, only for radiation of the same effective spectral distribution. In previous work comparison with the copper and aluminium absorption curves produced by constant potential has been established as a means of equating the qualities of X-ray beams excited by various voltage wave forms. Therefore a set of standard absorption curves is set up for Cu up to 180 kV (constant) and Al up to 110 kV (constant). Accurate evaluation of the wall absorption of the tubes used permits the establishment of basic absorption curves. Similar curves are given for potentials from 250 to

550 kV (constant) using a tube having 6 mm. of copper filtration. The effect of wall absorption on the relative position of the absorption curves is discussed, and it is shown how for any given excitation voltage a single curve may be used for a complete and adequate specification of X-ray quality. This may be contrasted with all other quality specifications, none of which is adequate without auxiliary information. AUTHORS.

2081. X-Ray Fluorescence Yield. D. K. Berkey. *Phys. Rev.* 45. *pp.* 437–440, *April* 1, 1934.—The fluorescence yield w_K has been measured by the ionisation method as developed by A. H. Compton [see Abstract 1888 (1930)] for thirteen elements. The following results have been obtained :

Element	w_K	*Element*	w_K	*Element*	w_K
27 Co	0·38	33 As	0·53	47 Ag	0·72
28 Ni	·39	34 Se	·55	48 Cd	·70
29 Cu	·43	38 Sr	·72	50 Sn	·66
30 Zn	·45	42 Mo	·79	51 Sb	·64
				52 Te	·59

These results show that w_K reaches a maximum value of 0·79 for molybdenum. It then rapidly drops to lower values for the heavier elements. AUTHOR.

2082. Crystal Wave-Length Measurements. P. Kirkpatrick and P. A. Ross. *Phys. Rev.* 45. *pp.* 454–460, *April* 1, 1934.—By observation of X-ray continuous spectrum isochromats the potential necessary for the production of general radiation capable of reflection from calcite at a known Bragg angle θ has been determined. By using a double spectrometer and tungsten source, and reflecting at the Bragg angle for Ag Kα_1 the value $V' \sin \theta = 2035 \cdot 3 \pm 0 \cdot 2$ international volts has been obtained. This is very close to Feder's value, 2036·0. In agreement with Feder it is concluded that Wagner's " low " value is in error because of experimental conditions and that this error can not now be rectified. It is shown that the " high " value of Duane, Palmer and Yeh is subject to certain calculable corrections which lower it to 2034·6, in much closer agreement with present results. The wave-length of Ag Kα_1 as given by the law of Duane and Hunt is found to be in agreement with the value obtained from crystal measurements and at variance with ruled grating results. Utilising crystal wave-length measurements by Bragg's law the present results yield $h/e^{4/3} = (1 \cdot 7559 \pm 0 \cdot 0002) \times 10^{-14}$ if Birge's (1929) auxiliary constants are employed, and 1·7563 with more recently determined values of five of these constants. Assuming the 1930 oil drop value $e = (4 \cdot 770 \pm 0 \cdot 005) \times 10^{-10}$ e.s.u. this investigation gives $h = (6 \cdot 546 \pm 0 \cdot 006) \times 10^{-27}$ erg. sec. AUTHORS.

2083. Current Progress in X-Ray Physics. D. L. Webster. *Science*, 79. *pp.* 191–197, *March* 2, 1934.—Consideration is restricted to the physics of X-ray emission. A short historical survey is given, beginning with Moseley's work and the progress made in the measurement of X-ray wave-lengths and intensity is outlined. The state of our present theoretical knowledge is given and comparisons between theory and experiment are made. J. T.

See also Abstracts 1982, 2091, 2092, 2144, 2215, 2221, 2223, 2231.

HEAT.

CALORIMETRY.

2084. Specific Heats of Vanadium, Niobium, Tantalum and Molybdenum from 0° to 1500° C. F. M. Jaeger and W. A. Veenstra. *K. Akad. Amsterdam, Proc.* 37. 2. *pp.* 61–66, 1934.—The metals tested were practically free from impurities, only traces of iron being present, and they were first brought into a " stabilised " condition by suitable heat treatment. They showed no indication of allotropic changes nor retardation phenomena. Values are tabulated for the true specific heat (c_p) and atomic heat (C_p) from 0° to 1500° C. for V and to 1400° C. for Nb, Ta and Mo. The measurements at each temperature were repeated several times, and the values given were proved to be reproducible within 0·1 to 0·2 % even at the highest temperatures. Equations are given for the variation of c_p and C_p with temperature for each of the four metals. Values of C_v are given for Ta and Mo, but they could not be obtained for V and Nb. R. S. R.

2085. Specific Heats and Thermal Retardation Phenomena of Beryllium. F. M. Jaeger and E. Rosenbohm. *K. Akad. Amsterdam, Proc.* 37. 2. *pp.* 67–76, 1934. A series of measurements of the specific heat of crystalline Be have been made near to 300°, 350° and 400° C. after various preliminary heatings and coolings. The results are tabulated and show irregular retardation phenomena due to the metal not returning after heating to its original condition. When the crystal was pulverised the retardation phenomena were not obtained owing to oxidation of the surface. It is considered that the phenomena are due to the presence of pseudo-components, δ and ϵ, of the metal which are in internal dynamical or mobile equilibrium. Changes are reversible, but do not take place at once. The momentary state of the metal, as composed of the two kinds of saturated mixed crystals, cannot be indicated with any degree of certainty since it depends on the more or less accidental content of δ and ϵ — Be acquired in the original process of preparation of the metal. R. S. R.

See also Abstracts 1761, 1778.

CONDUCTION.

2086. Heat Conduction in a Solid in Contact with a Well-Stirred Liquid. A. N. Lowan. *Phil. Mag.* 17. *pp.* 849–854, *April*, 1934.—For the case of a solid in the form of a cylindrical bar, impervious to heat except over the face which is in contact with a well-stirred liquid contained in a reservoir of the same geometrical form as the solid, and assuming that the heat transfer from the reservoir to a constant temperature enclosure is proportional to the temperature difference, a solution for the heat conduction is obtained by application of the Laplace transformation and the theory of loaded integral equations. The paper is entirely mathematical. R. W. P.

2087. Thermal Conductivity of Irons and Steels. S. M. Shelton. *Bureau of Standards, J. of Research*, 12. *pp.* 441–450, *April*, 1934.—The thermal conductivities over the temperature range 100° to 500° C. have been determined for 20 irons and steels which were selected as typical examples of commercial materials used for a variety of purposes and expected to have considerably different thermal conductivities. The data on the chromium-iron and chromium-nickel-iron alloys are of particular interest because of the lack of previous data for " stainless " steels. The apparatus was designed for comparative measurements and thus eliminated calorimetric or power-input determinations which are difficult to perform with uniformly high accuracy over a broad range of temperature. High-purity lead was used, either directly or indirectly, as the standard with which other metals were compared. The results indicate that, in general, the differences in conductivity of irons and steels are much smaller at high temperatures than at room-temperatures. High-alloy steels have lower thermal conductivities than low-alloy steels, and that of irons and low-alloy steels decreases with increase in temperature. An increase in the amount of alloying constituents in iron causes, in general, a decrease in thermal conductivity and an increase in the temperature coefficient. A fairly complete Bibliography of data on the thermal conductivity of iron and steel is given. [See Abstract 2089 (1934)]. AUTHOR.

2088. Thermal Conductivity of Transparent Liquids. T. W. Classen and J. Nelidow. *Phys. Zeits. d. Sowjetunion*, 5. 2. *pp.* 191–199, 1934. *In German.*—The method is based on the change of refractive index of a transparent liquid with temperature, and full details together with appropriate data are given. Two formulæ have been derived for the calculation of the temperature as a function of the angle of deflection of the beam which passes through a liquid layer possessing a temperature gradient. The possibility of using the Pulfrich refractometer for the determination of the coefficient of thermal conductivity is discussed, and the necessary supplementary apparatus described. H. H. Ho.

2089. Apparatus for Thermal Conductivity of Metals up to 600° C. M. S. van Dusen and S. M. Shelton. *Bureau of Standards, J. of Research*, 12. *pp.* 429–440, *April*, 1934.—Apparatus is described for measuring the thermal conductivity of metals up to 600° C. The method employed consists in comparing the conductivity of a metal, either directly or indirectly, with that of lead. Lead was selected as the standard since previous measurements have established its conductivity within fairly close limits. Determinations are made by measuring the axial temperature gradients in two cylindrical bars soldered together end to end, one end of the system being heated and the other cooled, and the convex surfaces protected from heat loss by a surrounding guard tube. Data are given on the conductivity of commercial nickel, high purity zinc, high purity nickel, and several commercial nickel-chromium and other alloys widely used for heating elements and thermocouples. [See Abstract 2087 (1934)].

AUTHORS.

See also Abstracts 1775, 1830, 1928.

CONVECTION.

2090. Heat Transfer in Fluids and the Displacement Pressure. M. F. Treer. *Phys. Zeits.* 35. *pp.* 266–268, *March* 15, 1934.—It is shown theoretically, that, for the case of heat transfer to or from a moving fluid, the dimensionless coefficient of heat transfer is equal to the product of the reduced displacement pressure and a coefficient which is characteristic of the fluid. Since this latter coefficient is a function of the temperature, but independent of the velocity, it becomes possible to divide the heat transfer coefficient into two factors, one being a function of the velocity and the other of the fluid temperature. R. W. P.

See also Abstract 2105.

DILATATION.

2091. Thermal Expansion of Calcite. J. Weigle and H. Saini. *Helv. Phys. Acta,* 7. 2. *pp.* 257–266, 1934. *In French.*—The coefficients of thermal expansion of calcite are determined by an X-ray method. A Seemann-Böhlin camera is used and the measurements are made at temperatures up to 290° C. The coefficient of thermal expansion is found to be $2\cdot10\times10^{-5}$ parallel to the axis, and $-0\cdot380\times10^{-5}$ perpendicular to the axis. Corresponding figures obtained by Benoit in 1888 are $2\cdot572\times10^{-5}$ and $-0\cdot5509\times10^{-5}$. It is concluded that the two methods can only be compared by using the same crystal in each case. [See following Abstract.] J. T.

2092. Thermal Expansion of Sodium Nitrate. H. Saini and A. Mercier. *Helv. Phys. Acta,* 7. 2. *pp.* 267–272, 1934. *In French.*—The coefficients of thermal expansion of $NaNO_3$ are determined by the method referred to in the preceding Abstract. $NaNO_3$ can be prepared pure and so can be used to compare macroscopic measurements of thermal expansion with X-ray methods. It is found that the coefficient parallel to the axis of symmetry is $(7\cdot53\times10^{-5})+(5\cdot1\times10^{-7}t)$, and perpendicular to the axis of symmetry is $(8\cdot8\times10^{-6})+(5\cdot4\times10^{-8}t)$. The result is compared with previously published results obtained by interference and volumetric methods. J. T.

2093. Measurements of Small Coefficients of Expansion. L. Dunoyer. *Comptes Rendus,* 198. *pp.* 909–911, *March* 5, 1934.—The methods available for measuring coefficients of thermal expansion of substances which expand very little, *e.g.*, fused silica, are briefly reviewed. A method is outlined which is based on measurements of the deformation which occurs when a temperature difference is maintained between two parts of a specimen of the substance. J. E. R. C.

2094. Expansion of Fused Silica. L. Dunoyer. *Comptes Rendus,* 198. *pp.* 1132–1134, *March* 19, 1934.—During investigations on the construction of fused silica spirit levels with large radii of curvature, experiments were made on the thermal expansion of silica at ordinary temperatures by a method mentioned [see preceding Abstract]. Temperature differences of 40° C. were established between two sides of the curved silica tube so that expansion changes the curvature. The curvature was measured by means of a mirror inside the tube. This method when applied to glass tubes led to a positive coefficient of expansion of $6\cdot9\times10^{-6}$ but fused silica was found to have a negative coefficient of $6\cdot6\times10^{-8}$. J. E. R. C.

2095. Optical Dilatometer. F. Bollenrath. *Zeits. f. Metallkunde,* 26. *pp.* 62–65, *March,* 1934.—The expansion of pure Al and of a number of its alloys over the range 0–500° C. and of pure Mg and a Mg-Al alloy over the range 0–400° C. is examined with the aid of an optical dilatometer which has already been described (*ibid.* 25. *pp.* 163–165, *July,* 1933). H. J. H. S.

2096. Expansion Characteristics of Some Common Glasses and Metals. E. E. Burger. *Gen. El. Rev.* 37. *pp.* 93–99, *Feb.,* 1934.—A method of measuring the expansion of rods of glass or metal when heated in an electric furnace up to a temperature of 600° C., is described, with details of the apparatus used in an investigation into the suitability of various glasses and metals for making seals in vacuum apparatus. The main advantage of the apparatus described is that relatively long samples, up to 12 in. in length, could be used. Curves are given showing the expansion characteristics of a number of common sealing glasses relative to tungsten, molybdenum and a chrome-iron alloy. W. D. W.

2097. Thermal Expansions of Soda-Lime-Silica Glasses as Functions of the Composition. B. C. Schmid, A. N. Finn and J. C. Young. *Bureau of Standards, J. of Research,* 12. *pp.* 421–428, *April,* 1934.—The linear thermal expansions from 25° C. to the "critical" and "softening" temperatures were determined for 19 soda-silica and 30 soda-lime-silica glasses by the interferometer method. Graphs have been prepared from which the critical temperature, softening temperature, the expansions to these temperatures, and the annealing range can be predicted approximately for any glass in the range of compositions studied. AUTHORS.

See also Abstract 1816.

MELTING AND BOILING POINTS.

2098. Condensation Phenomena in Mercury Vapour. P. C. Ho. *Cambridge Phil. Soc., Proc.* 30. *pp.* 216–224, *April* 30, 1934.—A cloud chamber containing mercury was connected to an expansion chamber through a long glass tube; the mercury could therefore be heated to give sufficient vapour for the condensation process while the expansion chamber was still at room-temperature. It was found essential to wash the inside of the chamber with fresh filtered air for several hours as the removal of dust particles by repeated expansions was a very inefficient method when mercury was the condensing vapour. The critical expansion ratios required to produce a cloud were determined for initial temperatures from 191° C. to 270° C. and varied from 2·68 to 2·158 when a definite volume change type of expansion was used. A definite pressure-change type of expansion produced different results but other considerations showed that there was no real discrepancy. The presence of X-rays does not appreciably increase the density of the cloud and it is concluded that condensation on ions does not occur with mercury vapour. This behaviour is to be expected theoretically since calculation shows that the uncharged nuclei have a radius of about 10^{-7} cm. and that the change in supersaturation required to produce condensation if these nuclei were charged amounts to only a few per cent. F. C. C.

See also Abstract 1877.

TEMPERATURE, MEASUREMENT OF.

2099. Reproducibility of the Ice Point. J. L. Thomas. *Bureau of Standards, J. of Research,* 12. *pp.* 323–327, *March,* 1934.—In order to test the ice point as a suitable temperature at which to measure pure-metal resistance standards, an investigation has been made of its reproducibility. The results obtained show that the ice point may be readily reproduced to a few ten thousandths of a degree centigrade. This result was arrived at by intercomparing different ice baths, and by comparing the ice point with the triple point of water. AUTHOR.

2100. Accurately-Recording Liquid-in-Glass Thermometers of Constant Performance. W. Grundmann. *Zeits. f. techn. Physik,* 15. 3. *pp.* 119–126, 1934.—The sources of error in liquid-in-glass thermometers are discussed both from their qualitative and quantitative standpoints in regard to their performance and utility as compared with mercury-in-glass thermometers. The limitations and particular virtues of both are compared. By means of experimental results it is shown that, with a certain red liquid, a constant-reading, permanent, exactly-indicating liquid thermometer can be made to work over a range from +250° C. to −120° C. with considerable efficiency. Compressibility, viscosity, nature of colouring material, gas absorption, etc., are discussed for certain creosote oils which prove suitable as the liquid medium employed. S. G. B.

2101. Technique of Sputtering Thermocouples. L. Harris and E. A. Johnson. *Rev. Sci. Instruments,* 5. *pp.* 153–158, *April,* 1934.—The adiabatic heat produced in a sound field up to frequencies of 5000 cycles has been measured with a thermocouple. Similar thermocouples have been used to measure small intensities of radiation. The response of these sensitive couples depends upon the use of thin films of metal and the use of a.c. amplification. The couples have been made by kathodic sputtering of bismuth, antimony and tellurium on thin cellulose. A detailed account of their construction is presented. AUTHOR.

2102. Testing of Refrigerating Plant. S. Rebecchini. *Ingegnere,* 8. *pp.* 159–166, *Feb.* 16, 1934.—This article is intended for the engineer who, in the course of his duties, may be called upon to test the refrigerating plant installed in a building. The first part is devoted to a brief outline of the general principles of operation of such a plant. A suggested routine for testing a new plant is then given, followed by a practical example. L. B. F.

2103. Magneto-Caloric Production of Extremely Low Temperatures. W. Meissner. *Phys. Zeits.* 35. *pp.* 303–310, *April* 1, 1934. —The lowering of temperature by magneto-caloric means is obtained by isothermally magnetising to a high degree a suitable paramagnetic body, the heat generated being absorbed with a suitable cooling agent. The body is kept in the cooling agent and is demagnetised adiabatically, whereby a cooling results. Thermodynamical reasoning leads to the expression $dT = -(TH\frac{\partial(Vx)}{\partial T}/C_p)\cdot dH$, where dT is the temperature change, H is the magnetising field, and x the susceptibility per cm.^{3}. To this may be added the Curie-Weiss law $x = C/T + D)$. This expression has been verified down to 1·3° Å for $GdSO_4$. The quantum theory is applied to the study of paramagnetic salts and the results of several workers in this field are examined and discussed and deviations from the theory are noted, tentative suggestions being made to account for them. The apparatus used by de Haas, Wiersma and Kramers is described in detail and some typical results obtained with it are given. The paper concludes with a list of references. H. J. H. S.

THERMOCHEMISTRY.

2104. Heat of Dissociation of Bi_2 Determined by the Method of Molecular Beams. Cheng Chuan Ko. *Frank. Inst., J.* 217. *pp.* 173–199, *Feb.,* 1934.—Using the velocity analyser of Zartman [see Abstract 2172 (1931)] the combined velocity spectrum of Bi atoms and Bi_2 molecules was obtained at various temperatures. From the spectral distribution curves the relative abundance of Bi atoms and Bi_2 molecules in the beams at the temperatures employed could be determined to 1 %. The vapour pressure curve of Bi was determined and the values so obtained were combined with the degree of dissociation of the vapour (as computed from the beams) to give the heat of dissociation. In calculating this latter, the equilibrium temperature was taken as that of the slit chamber, which was 24° C. above the crucible temperature. The results of these calculations gave the value of the heat of dissociation as 77,100±1200 cal. The curves for the distribution of velocities observed and computed on the assumption of a given ratio of Bi atoms to Bi_2 molecules in the beam were compared in an attempt to test the law of distribution of velocities. On the high velocity side agreement in two curves was obtained within the limits of experimental accuracy. On the low velocity side important deviations were noted such that the observed curves below a velocity $a/2$ (a being the most probable velocity) gave more molecules than the theory demanded. The nature of the variation at velocities less than $a/2$ indicated the presence of molecules of greater mass than Bi_2 in the beam, and at the lower temperatures a distinct peak corresponding to Bi_8 molecules was observed. A. H.

2105. Temperature Rise in a Heat-Evolving Medium. E. N. Fox. *Roy. Soc., Phil. Trans.* 232. *pp.* 431–461, *March* 14, 1934.—The theretical problem dealt with is that of heat conduction in a chemically reacting mass in which the rate of evolution is a function of the time. The conditions of this problem are essentially different from those of the corresponding astrophysical problem in which the mode of energy transfer is by radiation and not by conduction, or from those of the geophysical problem where the rate of evolution of heat is assumed to be independent of the time. The general equations of heat flow in a medium evolving heat at a rate constant throughout the medium but varying with time are first derived, and certain general results then deduced. Solutions of these equations are then obtained for what are probably the six most important cases of one-dimensional flow. In these solutions the effect of an initial gradient has not been included, since it can be simply taken into account by the addition of an auxiliary solution which satisfies the heat conduction equation for an ordinary medium and is therefore of well-known form. It has so far not been found possible to obtain a mathematical solution for the case when the rate of heat evolution varies with the temperature. The general theory, however, has been elsewhere applied with reasonable success to temperature rise in reacting concrete, the above mentioned difficulty being surmounted by means of an empirical correction. H. H. Ho.

2106. Twisting-Frequency in Ethylene. W. G. Penney. *Phys. Soc., Proc.* 46. *pp.* 333–337, *May* 1, 1934.—From the experimental value for the fundamental twisting-frequency in ethylene, the magnitude of a certain carbon-carbon exchange integral J is determined as $0 \cdot 72 \pm 0 \cdot 10$ electron-volts. According to this result, the energy needed to twist one of the CH_2 groups through an angle $\pi/2$ with respect to the other about the C-C axis is $1 \cdot 0 \pm 0 \cdot 2$. This agrees well with the experimental value for the heat of activation of dimethyl maleate to dimethyl fumarate. AUTHOR.

2107. Influence of H.F. Field on the Velocity of Combustion of Gases. A. E. Malinowski, W. S. Rossichin and W. P. Timkowski. *Phys. Zeits. d. Sowjetunion,* 5. 2. *pp.* 212–220, 1934. *In German.*—Diminution in the propagation velocities of flames in mixtures of acetylene with air have been studied in direct electric fields of 200–1500 volt/cm., and in alternating fields of 300–2900 volt/cm. and frequency of between 5 and $6 \times 10^5 \sim$, where the diminutions have been recorded as 1·4 to 100 % and 1·8 to 100 % respectively. The influence of the alternating field is 1·5 to 2·0 times weaker than that of the direct field. With increase of flame propagation velocity, the influence of the electric fields (both direct and alternating) diminishes. With increasing dilution in acetylene of rich mixtures (23 % C_2H_2+air). The difference between the direct and alternating fields diminishes continually until their influence becomes practically negligible. Such field influence as above could not be established for mixtures of hydrogen and air. H. H. Ho.

2108. Microscopic Study of Detonation. A. Michel-Lévy and H. Muraour. *Comptes Rendus*, 198. *pp*. 825–826, *Feb*. 26, 1934.—A description is given of the scattering of droplets of lead, formed by detonation of a fragment of lead azide, on a microscope slide. A. S. C. L.

2109. Explosion of Wire by Condenser Discharge. G. Vaudet. *Comptes Rendus*, 198. *pp*. 1217–1219, *March* 26, 1934.—The luminous effects accompanying the discharge of a condenser through a piece of copper wire have been examined photographically. Two principal regions are noted on the photographs, one dark at first and corresponding to the explosion proper and a larger region corresponding to the oxidation of the copper. The latter region is subdivided into three other regions which last for different periods. The effect of variation of the condenser voltage, etc., is investigated with particular reference to the duration of the explosion. J. E. R. C.

See also Abstracts 1761, 1792.

THERMODYNAMICS.

2110. Solution of Van der Waals' Gas Equation by a General Graphical Method. S. Rebecchini. *Ricerche di Ingegneria*, 2. *pp*. 16–21, *Jan.–Feb.*, 1934.—A graphical method is given which permits of obtaining from van der Waals' equation the specific volume of a gas in terms of the pressure, the temperature and the gas constants. The method consists in finding the intersection of a cissoid of Diocles, which can be constructed once for all, being the same for any gas, with a straight line whose intercepts on the axes are easily determinable functions of p, T and the constants. The method is used to deduce well-known results on the transformations of gases and their critical states. A. J. McC.

2111. Thermodynamics of Solid Solutions. Part I. H. Seltz. *Am. Chem. Soc., J*. 56. *pp*. 307–311, *Feb*., 1934.—Theoretical treatment. A. S. C. L.

2112. Connection between the H-Function and the Entropy according to the Fermi Statistic. M. Satô. *Zeits. f. Physik*, 87. 7–8. *pp*. 498–499, *Jan*. 26, 1934.—The connection between the H-function and the entropy S is given by $S=-KH$, where K is the Boltzmann constant. In this note the author discusses whether this relation exists in the Fermi statistic, with the conclusion that this connection does thus occur. J. J. S.

2113. Heat Capacity Curves of the Simpler Gases. Part IV. Entropy and Heat Capacity of CO and N_2. H. L. Johnston and C. O. Davis. *Am. Chem. Soc., J*. 56. *pp*. 271–276, *Feb*., 1934.—Entropy heat capacity and total energy of CO and N_2 from 50° to 5000° K. have been calculated from spectroscopic data. Rotational heat capacity curves are given for these gases. Both show maxima below the equipartititon level. Distribution of molecules among the various vibration levels is given as a function of temperature. [For Part III see Abstract 4171 (1933).] A. S. C. L.

2114. Thermodynamical Calculation of Normal Potentials. (Miss) M. Quintin. *Comptes Rendus*, 198. *pp*. 718–720, *Feb*. 19, 1934.—By means of a combination of the equation for the potential of cells without transport and the Gibbs-Helmholtz equation, an expression is derived for the calculation of normal potentials. The heats of reaction at infinite dilution are employed, and the equation for the normal potentials is found to be $E_0 = 0{\cdot}4042 - 0{\cdot}00050T$. F. J. B.

2115. Thermodynamics of Dilute Thallous Chloride Solutions. I. A. Cowperthwaite, V. K. La Mer and J. Barksdale. *Am. Chem. Soc., J.* 56. *pp.* 544–549, *March,* 1934.—The e.m.f. of the cell [Tl(solid) TlCl(*M*) AgCl Ag] has been determined by combining measurements on the cells [Tl(dilute amalgam) TlCl(*M*) AgCl Ag] and [Tl(solid) Tl_2SO_4 (0·03 *M*) Tl (dilute amalgam)] for temperatures from 0 to 50° employing TlCl of molalities from 0·0005 to 0·01 *M*. The logarithms of the activity coefficients of TlCl when plotted against the square root of the molality exhibit an experimental slope which is somewhat greater than the predictions of the Debye-Hückel limiting law in regions of high dilution, although at 25° the limiting slope is 0·506 in agreement with the theory, and in contradiction with conclusions drawn by Davies and others which were based upon data given by the solubility method at higher concentrations. The experimental results follow the predictions of the Gronwall, La Mer and Sandved extension of the Debye-Hückel theory when the parameter " a " is assigned a value of 0·93Å, but are more satisfactorily explained on the basis of incomplete dissociation. The value of the partial molal heats of dilution of thallous chloride computed by the aid of the Gibbs-Helmholtz equation have been tabulated. For the cell [Tl(solid) TlCl(*m*) AgCl Ag] at 25° C.—

$$E^0 = 0{\cdot}55833 \qquad -\triangle F^0 = 12{,}877 \text{ cal.}$$

$$dE^0/dT = 6{\cdot}646 \times 10^{-4} \qquad -\triangle H^0 = 8{,}307 \text{ cal.}$$

H. H. Ho.

2116. Thermodynamics of Aqueous Sodium Sulphate Solutions. H. S. Harned and J. C. Hecker. *Am. Chem. Soc., J.* 56. *pp.* 650–653, *March,* 1934.—Measurements of the cells

$$Pb(Hg)|PbSO_4|Na_2SO_4|Na_xHg|Na_2SO_4(0{\cdot}05)|PbSO_4(s)|Pb(Hg)$$

were made from 0° to 40° at 5° intervals, and from these calculations of the activity coefficient, the relative partial molal heat contents and specific heat of sodium sulphate in aqueous solution are computed. N. M. B.

See also Abstracts 1888, 2117, 2162.

VAPOUR PRESSURE.

2117. Partial Pressures of Formic and Acetic Acids above Aqueous Solutions and Their Partial Molal Free Energies at Molal Concentration. W. A. Kaye and G. S. Parks. *J. Chem. Phys.* 2. *pp.* 141–142, *March,* 1934.—The paucity of data pertaining to the vapour pressures of aqueous solutions of the organic acids has hitherto retarded thermodynamic calculations in this field. In the present study the partial pressures of formic acid above three of its solutions and those of acetic acid above two solutions have been measured at 25° C. From these results the partial molal free energies at molal concentration have then been derived. AUTHORS.

2118. Vapour Pressure of Fluorine. W. H. Claussen. *Am. Chem. Soc., J.* 56. *pp.* 614–615, *March,* 1934.—The vapour pressure of liquid fluorine has been measured from 6·3 to 75·2 cm. The vapour pressure is given by the equation $\log_{10}P$ (cm.) $= -462{\cdot}66/T + 8{\cdot}7202 - 0{\cdot}01656T$. The boiling point is calculated to be 85·21°K., a value correct within 0·1°. The heat of vaporisation is calculated to be 1560 cal./mol. from the Clausius-Clapeyron equation and $\Delta S = 18{\cdot}3$. Fluorine obeys Hildebrand's rule regarding the entropy of vaporisation. AUTHOR.

ACOUSTICS.

2119. Power Emitted by Circular Membranes. R. Ruedy. *Canad. J. of Research,* 10. *pp.* 244–251, *Feb.,* 1934.—Accurate formulæ are presented showing the power radiated by a stretched circular membrane vibrating with small amplitudes and an arbitrary number of nodal circles or diameters. When the nodes are circular, the sound emitted is expressed as a sum of the products of simple functions of ka, $J_0(2ka)$, $J_1(2ka)$ by the definite integral of $y^{2s}/(\kappa^2a^2/k^2a^2 - 1 + y^2)^2$ taken between the limits zero and unity. For values of $ka = 2\pi a/\lambda$ between zero and two, where the radius a is taken as 10 cm., the membrane vibrating in its fundamental mode emits between three and four times as much power as the piston having the same maximum velocity at its centre. The first and second overtones have about the same strength as the corresponding fundamental frequencies, so the power radiated increases less rapidly with frequency than when nodes are absent. [See also Abstract 1660 (1934).] AUTHOR.

2120. Gongs. A. Pomp and B. Zapp. *Kaiser-Wilhelm Inst. f. Eisenforschung, Düsseldorf, Mitt. Vol.* 15. *Part* 3. *Abh.* 220, 1933. *Engineer,* 157. (*Metallurgist*), *pp.* 105–108, *March* 2, 1934.—An investigation of the wire gongs used in the chiming mechanism of mantel clocks. The gongs are made from steel wire 40 to 70 cm. long and about 3·6 mm. dia. At the end by which the wire is attached it is tapered, over a length of 35 to 40 mm., down to 2 mm. dia., and the last 10 mm. are left cylindrical. These measurements are the best for duration of tone. Further, a flat surface 1 to 1·5 mm. wide is filed on the side of the cone. The gongs are bent into flat spirals to economise space, and are sounded by blows, close to the point of support, from a metal hammer with leather facing. Four oscillograms of gong vibrations are shown, two for good gongs, and two for bad. In the unsatisfactory gongs, the successive changes of amplitude are more abrupt than in the other two. Also the graphs of good gongs contain well-defined overtones of audio-frequency, particularly the third. There is no correlation between composition or mechanical properties and acoustical effects, but the best results are obtained when the micro-structure is very fine, with spheroidised cementite. The gongs examined were made from hypereutectoid steel with 1 % carbon. G. E. A.

2121. Gramophone Horn. J. Larmor. *Cambridge Phil. Soc., Proc.* 30. *pp.* 242–248, *April* 30, 1934.—The paper illustrates the problems of general linear propagation mainly by analysis of the conditions necessary for effective resonance. The type chosen is that of a resonating horn made up of two cones joined together. The result gives a relation between the working alternating pressure of the capsule and the pressure spread over the mouth of the horn and transmitted away in air waves. For efficiency, five quantities are adjustable to give a pressure ratio as nearly constant as possible in the range of frequency utilised. Another theory broached is that of the relation of the arterial pulse to the blood-flow, first explored by Young in 1808. G. E. A.

2122. Diffraction of Light by Ultrasonic Waves. P. Debye, H. Sack, and F. Coulon. *Comptes Rendus,* 198. *pp.* 922–924, *March* 5, 1934.—ν_0, ν^1, being the frequencies of the incident light and ultrasonic waves respectively, the frequency of the diffracted wave of the *n*th order is $\nu_0 \pm n\nu^1$; for 5460 Å the variation when $n = 1$ is approximately 10^{-4} Å. A method of verifying this is described consisting essentially in passing the light before subjection to the ultrasonic waves through a Kerr cell (with nicol on each side), the same induction coil exciting both ultrasonic waves and Kerr cell. C. A. S.

2123. Recent Developments in Architectural Acoustics. V. O. Knudsen. *Rev. Modern Physics,* 6. *pp.* 1–22, *Jan.,* 1934.—A comprehensive survey of the subject from the point of view of the physicist rather than the constructor, the main features treated being :—Modifications of the reverberation formula introduced by the assumption of discontinuous absorption by the walls and absorption by the air [see Abstract 5390 (1933)] ; reverberation regarded as the free damped vibration of air confined in a room ; reverberation measurements ; the relation between the absorption coefficient and the acoustical impedance of a material ; the *modus operandi* of absorption by a porous material ; optimal reverberation times ; the transmission loss in rigid, non-porous walls and the calculation of sound insulation and noise-reduction in buildings. E. J. I.

2124. Sound Insulation of Plastic, Liquid and Granular Materials. A. Gemant. *Phys. Zeits.* 35. *pp.* 167–171, *Feb.* 15, 1934.—The principle of Meyer's method [see Abstract 3161 (1931)] is employed in measuring the energy intensity of a sound before and after passing through a partition made of the test material. A sound, of frequency which could be varied between 200 and 3200, was made in one box and passed through the partition to another box. In each box was a receiving condenser-microphone connected to an external amplifier and voltmeter. The insulating power i is expressed by $i = 20 \log (\mathrm{k}V_1/V_2)$, where V_1 and V_2 are the output volts of the amplifiers of the incident and emergent sounds respectively. Plates of plastic material have greater insulating property than rigid plates to the amount of 1 phon. Liquids such as water and oil are 2 phon better than solids. Granules, such as sand, are equally good, the probable cause of superiority in these two cases being the reduction of the nodal distance whereby the effective mass, and hence the insulation, is increased. G. E. A.

2125. Electrical Measurement of Small Vibrations. J. Obata, S. Morita and Y. Yoshida. *Tokyo Univ. Aeronaut. Research Inst., Report* 103. *pp.* 255–268, *Feb.,* 1934. *In English.*—An electrical arrangement for measuring small vibrations by means of a vacuum tube is described. As no electrical oscillation is started in the circuit, the calibration may be kept constant for a much longer period than in a similar arrangement described in earlier papers [see Abstract 1575 (1933)] in which an oscillating circuit was used. The results of applying this method to the measurement of vibrations of airscrew blades are also described. AUTHORS.

2126. Molecular Absorption of Sound in Gases. Y. Rocard. *Comptes Rendus,* 198. *pp.* 802–803, *Feb.* 26, 1934.—If sound passes through a gas, most of the molecules of which are without vibrational energy, the alternating temperature effects will cause variations in the number of such molecules. The resulting absorption of energy is discussed and the following facts pointed out : (*a*) that from measurements of the absorption of sound in air it may be deduced that under normal conditions only 1/100 of the molecular energy is vibrational, (*b*) that the critical frequency for air is about $8 \times 10^5 \sim$, (*c*) that at this frequency the absorption is mainly due to the above-mentioned effect, (*d*) above the critical frequency the absorption is principally due to viscosity, conductivity, etc., and (*e*) at audible frequencies the molecular absorption is of greater importance than the absorption due to viscosity and conductivity. J. E. R. C.

2127. Acoustical Studies. Part III. Rates of Excitation of Vibrational Energy in CO_2, CS_2 and SO_2. W. T. Richards and J. A. Reid. *J. Chem. Phys.* 2. *pp.* 193–205, *April*, 1934.—Measurements were made on these gases at various pressures, temperatures and frequencies. Double collisions provide the predominant mechanism of excitation. The van der Waals or capillary forces follow the acoustical cycle without lag under the conditions of the experiments. The velocity of sound at 9 kc. in CO_2 shows that a part of the heat capacity has already disappeared at this frequency. The remaining vibrational energy terms disappear together from the acoustical cycle, their rates of excitation being sensibly equal. Considerable activation energy is necessary to excite the deformation vibration. The velocity of sound at 9 kc. in CS_2 agrees well with that obtained by calculation from the results of band spectral analysis and hence no important energy terms appear to be lacking at this frequency. The symmetrical linear ($S \leftarrow C \rightarrow S$) and the deformation ($S \downarrow C \uparrow S \downarrow$) vibrations leave the acoustical cycle together at high frequencies or at low pressures. Study of the dispersive region caused by this disappearance shows that the rates of excitation of the various energy states are identical within limit of error, and that thus the activation energy of collision is uniform throughout the dispersive region. [See Abstract 4992 (1933) and following Abstract.] J. J. S.

2128. Acoustical Studies. Part IV. Collision Efficiencies of Various Molecules in Exciting the Lower Vibrational States of Ethylene. Excitation of Rotational Energy in Hydrogen. W. T. Richards and J. A. Reid. *J. Chem. Phys.* 2. *pp.* 206–214, *April*, 1934.—From determinations of the velocity of sound in pure ethylene at various pressures, temperatures and frequencies it is concluded that equilibrium is attained between the various states of the vibrational energy on every effective collision, but that a considerable activation energy of collision is required for the conversion of translational into vibrational energy. Collisions with A, He, and N_2 molecules have no appreciable effect on the vibrational energy of the ethylene molecule. Collision with H_2 molecules are about ten times as effective as ethylene-ethylene collisions in producing transitions in the lower vibrational energy states of ethylene. At ultrasonic frequencies H_2 shows a dispersive region apparently due to the failure of the rotational energy transitions to follow the acoustical cycle. Ethylene-hydrogen collisions appear to be about twenty times as effective as hydrogen-hydrogen collisions in exciting the rotational energy of H_2 molecules. [See preceding Abstract.] J. J. S.

See also Abstracts 1842, 1988, 1994, 2101, 2234.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

2129. Valve Detector for Supply Frequencies. W. S. Stuart. *Journ. Sci. Instruments,* 11. *pp.* 121–123, *April,* 1934.—An arrangement of thermionic valves is described which is intended to replace the vibration galvanometer in a.c. potentiometer work at low frequencies. The advantage gained is rapidity in operation due to the indications being made on a permanent-magnet moving-coil instrument. AUTHOR.

2130. Structural Analysis by Electric Circuit Analogies. V. Bush. *Frank. Inst., J.* 217. *pp.* 289–329, *March,* 1934.—Electric circuits may be constructed which obey the same laws as structures under load. Measurements on the circuits will then give the stresses, deflections, etc., of the corresponding structures. Circuits are given for determinate and indeterminate pin-connected and rigidly-connected structures in the static and the dynamic state. Experimental work is reported on relatively simple typical cases to show the apparatus and methods of measurement which are applicable, and the precision obtainable. AUTHOR.

See also Abstract 2151.

CONDUCTION AND DISCHARGE IN GASES.

2131. Application of Laws of Similarity to Conduction of Electricity in Gases. H. Mache. *Phys. Zeits.* 35. *pp.* 296–299, *April* 1, 1934. —Corrections are made to certain results previously obtained for cylindrical condensers [see Abstract 2087 (1932)] and the theoretical treatment is extended by consideration of three different types of ionisation chamber. A. W.

2132. Theory of Positive Column with Moving Striations. M. J. Druyvesteyn. *Physica,* 1. *pp.* 273–280, *Feb.,* 1934. *In German.*—The equations for the homogeneous positive column in the noble gases are extended so that they can be applied to the positive column with moving striations. An approximate solution of these equations is then given, whose characteristics resemble those of the moving striations. Calculation of the distance apart of the striations and of the velocity in Ne gives results of the same order of magnitude as were found experimentally by Elenbaas. The theory does not answer the question as to when a homogeneous column and when a column with moving striations should occur, but it shows the possibility of the occurrence of moving striations and permits an estimation to be made of their velocity and distance apart. A. W.

2133. Dependence on Frequency of the Form of the A.C. Glow Discharge, due to Ionic After-Effects. O. Brandt. *Ann. d. Physik,* 19. 3. *pp.* 290–298, *Feb.,* 1934.—The author observed and photographed the changes in appearance of the a.c. glow discharge at frequencies ranging from 50 to 10^6 cycles. By a stroboscopic arrangement, the changes in appearance during a cycle could be followed. At low frequencies, the discharge at any instant was of the same type as a d.c. discharge in one or other direction, but as the frequency was increased, at a particular frequency a dark break in the positive column appeared, the result, no doubt, of residual charges from the previous phase. As viewed by the unaided eye, the discharge developed two symmetrically disposed dark spaces which persisted to the highest frequencies. W. S. S.

2134. Luminescence of Rarefied Gases due to H.F. Currents. F. Esclangon. *Ann. de Physique,* 1. *pp.* 267–406, *March,* 1934.—The work described deals with the luminescence of rarefied gases in the interior of a solenoid traversed by sustained h.f. currents. The wave-lengths used were from 50 to 150 m., the power available being 3 kW. The results obtained show the existence of two régimes of luminescence, the first at low excitation, giving little light, the second very brilliant and only appearing with more intense excitation and a certain range of pressure. The first régime is found to be due to the preponderating action of the electrostatic field, the second to the action of induced currents. The induced field alone is incapable of starting the luminescence, but can maintain the second régime when once started. The passage from one régime to the other is in general discontinuous and marked by sharp limits, though the starting of the second régime is more capricious than its extinction. Using low pressures and a coil little greater in diameter than the discharge tube, so that the currents due to the electrostatic component were appreciable, the change from one régime to the other was continuous and only shown by the passage of the potential at the coil terminals through a maximum and minimum. Spectroscopic examination of the light shows normal arc or band spectra. Study of the fine structure of the green Hg line and of the intense Cd lines in the visible spectrum shows the lines given by the h.f. discharge to be identical with those obtained when using d.c. A. W.

2135. Investigation of Gas Discharges by Use of Directed Probes. D. v. Oettingen. *Ann. d. Physik,* 19. 5. *pp.* 513–532, *March,* 1934.—The phenomena in the first layer of the positive column and the adjacent part of the Faraday dark space of a nitrogen discharge were investigated by means of a special probe screened on one side. The measurements of the space potential were not affected by electron drift, but nevertheless the measurements, in conjunction with field strength where the probe is located, give different space potentials on the two sides of the probe, the difference amounting to many volts. The direction of this p.d. corresponds to the direction of the electric field obtaining at the probe. The difference vanishes in regions of no electric field. Measurements made with the Langmuir type of probe give a mean value. Electron temperatures measured on the anode and on the kathode side of the probe were the same. Disturbance of the discharge by the probe was shown by the fact that measurements on the kathode side of the probe gave almost double the electron concentration found on the anode side. The difference is independent of the gas pressure, the current density, the directed and the undirected electron velocity. The mean velocity of the undirected motion of the electrons exceeds the directed velocity by one or two powers of ten. The occurrence of S-shaped curves in the ionisation region of the layer appears to be a consequence of the ionisation of excited metastable nitrogen molecules. Metastable conditions occur in the feebly luminous portion of the layer near the anode. A. W.

2136. Kathode Fall in Hydrogen Arc. F. H. Newman. *Phil. Mag.* 17. *pp.* 830–833, *April,* 1934.—In order to discover the mechanism of an electric arc the kathode fall of potential is examined by a collector made of a tungsten rod turned to 1 mm. for 10 mm. at one end, as the distance between the electrodes is of the order 5 mm. The results show too high falls of potential at the kathode and anode, probably because the collector cannot be placed near enough to the electrode. It is found that the ionising potential of tungsten does not enter into the problem, although the kathode fall is greater than the ionisation potential of hydrogen. It appears that the type of arc used is intermediate in character between a purely metallic arc and an electric discharge. H. M. B.

2137. Ionisation of the K-Level by Electron Collision. D. Soden. *Ann. d. Physik,* 19. 4. *pp.* 409–433, *Feb.,* 1934.—The excitation of the K-level in heavy atoms by electrons whose energy is only slightly higher than the ionisation potential is discussed. In distinction from Born's treatment, the effect of the potential field of the atom is taken into account in the unperturbed eigenfunction of the colliding electron, and the calculation is made for those collisions which raise the K-electron to an excited *s*-state. The probability of exciting a given level in the atom is a maximum when the energy of the colliding electron is just sufficient for the excitation. The total probability of ionisation by transitions of K-electrons to excited *s*-states has a maximum at 1·9 times the ionisation potential. Taking account of transitions to *p*- and *d*- states, and of exchanges, the maximum of the total ionisation function for light atoms is displaced to about 3½ times the ionisation potential. On account of relativity, it is higher for heavier atoms, and for very heavy atoms, no maximum occurs at all. The theory is in good qualitative agreement with the experiments of Webster. C. B. A.

2138. Theoretical Investigations of the Mass Spectrometer without Magnetic Field. R. Herzog and J. Mattauch. *Ann. d. Physik,* 19. 4. *pp.* 345–386, *Feb.,* 1934.—A discussion is given of the theory of a mass spectrometer which has been previously described [see Abstract 706 (1933)]. In this a magnetic field is not used and the measurements are obtained by means of suitable h.f. fields and an electric radial field. Methods of warding off disturbing effects and avoiding sources of error are described. J. J. S.

2139. Electron-Optical Braun Tubes. M. v. Ardenne. *Zeits. f. Physik,* 88. 3–4. *pp.* 251–259, *March* 19, 1934.—The conditions necessary for the smallest fluorescent spot to be obtained in a high-vacuum Braun tube are outlined. The relation between the magnification and the distances of the object and image for an electron-optical lens system (consisting of a double electrode lens with a Wehnelt cylinder) is calculated and verified experimentally. The influence of the Wehnelt cylinder on the magnification is discussed. The constructional principles are the same as for a gas-filled tube. A simple method of making the ray paths visible is described. An examination is made of the forming process of an oxide kathode using the lens system described. H. J. H. S.

2140. Synthesis of Ammonia in the Electrodeless Discharge. W. C. Schumb and L. Goldman. *Am. Acad., Proc.* 69. 4. *pp.* 169–188, *Jan.,* 1934.—A study is made of the synthesis of ammonia from a stoichiometric mixture of N_2 and H_2, at pressures from 0·5 to 1·5 mm., by an electrodeless discharge for the wave-length range 200–330 mm., with current strengths of 5 to 8 amperes in the solenoid. The calculations of the amount of NH_3 synthesised from the observed pressure changes, after driving out the gases adsorbed by the walls, were shown, by colorimetric determinations on the resulting gas mixture, to correspond with the quantity of NH_3 contained in the system. Since the synthesis is known to be a wall reaction, various expedients were tried to observe the effect of the extent and condition of the exposed wall surface, and from the data obtained a hypothesis is advanced, accounting for a number of aspects of the wall effect, for the mechanism of the reaction. Much larger pressure drops are obtained in a static than in a circulatory system, though in the latter more NH_3 is formed, the percentage distribution between wall and gas space being the same in both cases. The percentage of synthesis of NH_3, plotted as a function of frequency, passes through a maximum. The above-mentioned hypothesis leads to the conclusion that the law of mass action should not apply to this case, as it is not a homogeneous gas phase reaction. N. M. B.

2141. Properties of Arced Gases. B. W. Bradford and G. I. Finch. *Chem. Soc., J. pp.* 360–365, *March*, 1934.—The properties of streams of gases excited by previous passage through a h.t. arc have been examined and their mutual interactions studied in relevant cases. The afterglows observed in several arced gas streams, testify to the existence therein of molecules in metastable states of relatively high levels of excitation. Previous arcing, however, was found to be without effect upon the ignition temperatures observed in mixed H and O streams. It is indicated that whatever rôle atomic H as such may play in the homogeneous combustion of H by O, it certainly does not act therein as a promoter ; a view in conflict with the conclusions of Haber, Taylor and others, according to which H is an essential and all-important active member in their postulated reaction chains. The results obtained on mixing arced dry streams of CO and O_2, are in agreement with the facts relating to the kathodic combustion of such mixtures, and show the reluctance of CO to combine with O directly, *i.e.*, without the intervention of steam or metal atoms. No interaction occurred with O when the H steam alone was arced, and only traces of combustion could be detected when arced O was mixed with unarced H. H. H. Ho.

2142. Insulating Films Formed Under Electron and Ion Bombardment. R. L. Stewart. *Phys. Rev.* 45. *pp.* 488–490, *April* 1, 1934.—In an evacuated tube in which the slightest traces of organic vapours may occur, even with liquid air cooling, insulating layers are formed on surfaces subject to electron or canal-ray bombardment. These layers may be attributed to carbon compounds, and their formation is related to the polymerisation of organic vapours by electrical discharges, α-particles, and ultra-violet light. The simple ion-deposition theory is inadequate as the layers are formed only at the point of impact of the rays on the surface. Electrical resistances and breakdown potentials were observed for several films. The importance of these deposits in general experimental practice, such as the photometry of mass-spectra, is pointed out, and, amongst others, cases are cited of their influence in producing contact potentials, pseudo high vacua, erroneous photographic recording and differential condensation of vapours upon previously bombarded surfaces. AUTHOR.

2143. Automatic Wilson Cloud Chamber of Simple Design. A. J. Dempster. *Rev. Sci. Instruments*, 5. *pp.* 158–160, *April*, 1934.—An expansion chamber with sylphon-bellows similar to that of Dahl, Hafstad and Tuve [see Abstract 3750 (1933)] but with the electromagnetic release replaced by a compressed spring is described. The combination of spring and chamber forms an oscillating system and the expansion consists of one half-vibration, the time of which is 0·026 sec. Four small electromagnets hold the piston down and prevent further oscillations. A photograph of the apparatus is given together with oscillation diagrams with and without excitation of the magnets. Slight eddies were present but these were eliminated by a nickel gauze as originally suggested by Wilson. [See Abstract 5016 (1933).] F. C. C.

2144. Simple Type of Cloud Chamber. P. C. Ho and E. C. Halliday. *Cambridge Phil. Soc., Proc.* 30. *pp.* 201–205, *April* 30, 1934.—The behaviour of the new type of cloud chamber described by Wilson [see Abstract 5016 (1933)] is compared with that of the common piston type. The chamber is tested with X-rays, γ-rays and α-rays from radio-thorium and photographs are reproduced which show that satisfactory results can be obtained over a range of final pressures in the chamber from atmospheric down to 7 cm. of mercury. F. C. C.

See also Abstracts 1969, 1997, 2033, 2098.

CONDUCTION IN SOLIDS AND LIQUIDS.

2145. Lorentz-Lorenz Correction in Metallic Conductors. R. de L. Kronig and H. J. Groenewold. *Physica,* 1. *pp.* 255–264, *Feb.,* 1934. *In English.*—The quantum theory of dispersion in metals [see Abstract 793 (1932)] is generalised so as to take into account not only the direct action of an incident light wave upon the different electrons of the metal but also the influence which each of these suffers from the induced periodic motion of the others. The effect of the new correction on the position and strength of the resonance frequencies of the system is illustrated for a special case. AUTHORS.

2146. Electron Theory of Metallic Conduction. H. Jones and C. Zener. *Roy. Soc., Proc.* 144. *pp.* 101–117, *March* 1, 1934. The authors give general proofs of certain equations which are known to be true for free electrons in metals and are assumed to remain valid for electrons moving in a periodic potential field, such as occurs in a metallic crystal. The points discussed are the relationship between the average velocity of an electron in a given stationary state and the distribution of eigenenergies, and the effect of constant electric and magnetic fields on the motion of electron wave packets. W. S. S.

2147. Electronic Motion in Crystal Lattices. D. Blochinzew. *Phys. Zeits. d. Sowjetunion,* 5. 2. *pp.* 316–343, 1934. *In German.*—Bloch's theory of the metallic and semiconducting states [see Abstract 1449 (1929)] is generalised, taking into account degenerate terms. The wave functions occurring in the theory are developed as converging Fourier series. J. S. G. T.

2148. Sensitive A.C. Galvanometer. E. Gambetta. *Comptes Rendus,* 198. *pp.* 551–553, *Feb.* 5, 1934.—A.c. instruments may be divided into three classes (1) those in which the reading is proportional to the square of the current (*e.g.* idiostatic electrometers); (2) those in which the readings near zero obey a parabolic law (*e.g.* triode electrometers), and (3) those in which the readings are proportional to the currents (*e.g.* electrodynamometers). The last-named type is either delicate or insensitive. In the present paper a sensitive linear instrument is described in which the current to be measured, together with an auxiliary current, are rectified by means of a copper-oxide rectifier and the rectified output measured by a moving-coil galvanometer. The effect of the auxiliary current (which may be continuous) is eliminated, so that the instrument is direct-reading. It is claimed that with a Deprez-d'Arsonval galvanometer having a resistance of 860 ohms and a period of 9 sec. an a.c. of 5×10^{-9} ampere may be measured. G. E. B.

2149. Measurement of Alternating Currents. W. Bader. *Arch. f. Elektrot.* 28. *pp.* 139–154, *March* 15, 1934.—A circuit is described which has moving-coil sensitivity for low and medium frequency alternating currents. The measuring coil is hung in the cylindrical gap of a 4-pole magnetic circuit and tilts when the latter is externally excited. The theory of the system is fully worked out, indicating how currents can be measured both in phase and magnitude. L. E. C. H.

2150. Valve Amplification of Small Alternating Voltages. N. Vermes. *Zeits. f. Physik,* 87. 9–10. *pp.* 647–658, *Feb.* 3, 1934.—In the usual treatment of the amplification of small alternating voltages by triodes, the effect of grid current is neglected in the interests of simplicity. In the present paper proper consideration is given to the grid current, and a mathematical treatment is developed, numerical values being calculated for a number of different circuit conditions. G. E. B.

2151. Highly Sensitive Two-Valve Electrometer. E. Hasché. *Ann. d. Physik,* 19. 5. *pp.* 484–488, *March,* 1934.—An arrangement of a two-valve electrometer bridge circuit with a differential galvanometer is described. Circuit diagrams are given; the original paper should be consulted. F. C. C.

2152. Indirectly Heated Valves in D.C. Amplifiers. P. Donzelot, E. Pierret and J. Divoux. *Comptes Rendus,* 198. *pp.* 912–913, *March* 5, 1934.—The fluctuations mentioned in the author's previous paper on d.c. amplifiers [see Abstract 4222 (1933)] are discussed. An amplifier of the Wheatstone bridge type using indirectly heated tetrode valves is found to be found much more stable than a bridge using ordinary tetrodes. This is attributed to (*a*) the steadiness of the distribution of field between grid and plate, (*b*) to the independence of the kathode temperature of the plate current, and (*c*) to a large thermal delay, reducing the fluctuations due to kathode heating by radiation from the anode. J. E. R. C.

2153. Pure-Metal Resistance Standards. J. L. Thomas. *Bureau of Standards, J. of Research,* 12. *pp.* 313–321, *March,* 1934.—National standardising laboratories use wire-wound standards for maintaining the unit of electrical resistance. The material for these standards is usually manganin, an alloy of copper, nickel and manganese. This alloy corrodes rather readily and in general its resistance does not remain as constant as is desired. It is believed that coils of pure metals, especially the noble metals, will be more stable in resistance and might be used to maintain the unit. Pure-metal standards have been constructed of copper, silver, tin, gold and platinum wire, and measured at the ice point. The gold and platinum coils have been very stable in resistance. The construction, method of measurement and results are given. AUTHOR.

2154. Temporal Variations of Current Intensity in a Semi-Conductor Subjected to a Weak Tension (E.M.F.). G. Déchêne. *Comptes Rendus,* 198. *pp.* 1021–1023, *March* 12, 1934.—In continuation of previous work [see Abstract 3759 (1933)] the author describes the variation with time of the resistance, kathodic and anodic potential drops exhibited by semi-conductors, including yellow HgO, $PbCl_2$, ZnO and Na_2CO_3, subjected to various potential drops ranging from 2 to 90 V. The effect of reversal of the voltage drop is also discussed. J. S. G. T.

2155. Supraconductivity. C. J. Gorter and H. Casimir. *Physica,* 1. *pp.* 306–320, Feb., 1934. *In English.*—In this paper a phenomenological treatment of supraconductivity is given, based on the fundamental laws of thermodynamics and on the assumption that the magnetic induction inside a supraconductive body is zero. After a brief survey of new experiments upon supraconductivity these ideas are applied to the case of a body entirely in the supraconductive state. Then the transition process for a needle parallel to a magnetic field is considered, and an equation is derived connecting the jump in specific heat and the derivative of the magnetic threshold value with respect to temperature (Rutger's equation). These considerations are then applied to a more general system of supraconductive bodies; in this case there will be a continuous transition process. Further, a detailed treatment is given of the disturbance of the supraconductivity of a cylinder by a current flowing in the cylinder, and Silsbee's hypothesis is confirmed. In conclusion, the results obtained and the experimental evidence for the assumptions are discussed. Mention is made of some questions which remain as yet unsolved. L. A. W.

2156. Electrical Conductivity Defect Phenomena of Cuprous Iodide. K. Nagel and C. Wagner. *Zeits. f. phys. Chem.* 25. *Abt. B.* 1–2. *pp.* 71–80, 1934. — The electrical conductivity of cuprous iodide from 40° to 300° is found to be a unique function of the iodine vapour-pressure of the surrounding atmosphere; the higher the pressure, the greater the conductivity. The consumption of the so-called electron-defect conduction is invoked to account for the qualitative significance of this phenomenon, and this is confirmed by thermal measurements at different iodine vapour-pressures. The same conclusion is drawn from Steinberg's Hall-Effect measurements, according to the Heisenberg theory. The relative conductivity of the copper-ion is found to be about $2 \cdot 7 \times 10^{-6}$ at 200° and for an iodine vapour pressure of 46 mm., and that due to the total copper as $1 \cdot 8 \times 10^{-4}$ ohm.$^{-1}$ cm.$^{-1}$, a value greater than the Tubandt and Baudouin figure for iodine free copper iodide at the same temperature. The results are explained by assuming places of electron deficiency and empty spaces in the Cu^+ ion lattice. Ascending experiments of copper in iodine have been carried out at 200° C. and calculations made which are valid when a wandering of Cu^+ ions + electrons in the direction metal → iodine phase is assumed. H. H. Ho.

2157. Conductance of Aqueous Solutions as a Function of Concentration. Part I. Potassium Bromide and Lanthanum Chloride. G. Jones and C. F. Bickford. *Am. Chem. Soc., J.* 56. *pp.* 602–611, *March*, 1934.—The electrical conductance and density of solutions of KBr at concentrations from 0·00025 to 3·75 *M*., and of lanthanum chloride from 0·00025 to 1·0 *M*. were determined at 0 and 25° C. The results showed that the Jones and Dole equation gave values which agreed with the experimental data for both salts, at both temperatures, and up to higher concentrations better than any other known equation. The Shedlovsky conductance equation agreed with the data for KBr up to 0·1 *N* better than any other equation, but the equation was not applicable to the data for lanthanum chloride. F. J. B.

2158. Anomalous Electrolytes. Part III. P. Walden and E. J. Birr. *Zeits. f. phys. Chem.* 168. *Abt. A.* 2–3. *pp.* 107–123, 1934.—This paper continues previous work [see Abstract 4230 (1933)] on the special behaviour of aromatic nitro-hydrocarbons in hydrazine as solvent, and investigates the conductivity of the perchlorates of tertiary amines, *e.g.*, tri-p-tolylamine, tetra-p-tolylhydrazine, and p-anisyl-diphenyl-methyl, in nitrobenzene and benzonitrile solutions at 25° C. over a wide range of dilution; these perchlorates are found to behave as strong binary salts, in which the free amines are the kations. The $SbCl_5$ compounds of the same amines and hydrazines were also examined. The mobilities of the kations can be approximately evaluated. H. H. Ho.

2159. Electrical Conductivity and High-Voltage Polarisation in Sodium Nitrate Crystals. Part III. B. Hochberg. *Phys. Zeits. d. Sowjetunion,* 5. 2. *pp.* 253–270, 1934. *In German.*—A continuation of previous work [see Abstract 1349 (1931)]. For a series of crystals it is found that continued tempering leads to a proportionate dispersion of the impurities. By passing a current through tempered crystals a space charge of constant thickness is formed. The thickness of the space charge increases with the number of impurities present and almost linearly with the electrical conductivity. A study of the ohmic and residual currents shows that the giving up of the ionic charge at the electrode increases rapidly with increase of electrical field at the electrodes. The relation between the polarisation and the presence of colloidal impurities is discussed and several difficulties encountered are considered. [See following Abstract.] R. L.

2160. Electrical Conductivity and High Voltage Polarisation in Sodium Nitrate Crystals. Part IV. A. M. Bontsch-Bruewitsch and B. M. Hochberg. *Phys. Zeits. d. Sowjetunion,* 5. 2. *pp.* 271–286, 1934. *In German.*—The formation of the space charge in $NaNO_3$ crystals is investigated in the region 30–74° C. The thickness of the space charge increases with increasing temperature. In the temperature interval considered the electrical conductivity increases about 20 times, while the thickness of the space charge is doubled. The crystals were tempered between platinum electrodes and the thickness of the space charge determined. The possibility of determining the relative quantity of diffused impurities (in relation to that already present in the crystals) from the amount of polarisation, is considered. The results obtained show that there is a possibility of studying by this means the diffusion of small concentrations of impurities where this appears to be impossible by chemical analysis. [See preceding Abstract.] R. L.

See also Abstracts 1765, 1816, 2016, 2109, 2188, 2189.

DIELECTRICS AND CAPACITANCE.

2161. Rochelle Salt in the Region of Spontaneous Orientation. I. Kurtschatow. *Phys. Zeits. d. Sowjetunion,* 5. 2. *pp.* 200–211, 1934. *In German.*—In a previous paper [see Abstract 3183 (1933)] it was shown that with Rochelle salt and certain other crystals, the polarisation of the medium under the influence of an electric field can be described by the Debye theory. It is now shown from an experimental study of crystal re-orientation that the process of spontaneous orientation may be expressed by the formula $Q_t=Q_0\,e^{-\alpha t/Q_0}$, where Q_0 and Q_t are the charges of the electrodes at times $t=o$ and $t=t$, and α is a constant which depends on the temperature. H. H. Ho.

2162. Dielectric Constants of Ethyl Behenate and the Molecular Volumes of Ethyl Behenate and Hexacosane in the Solid State. R. Buckingham. *Faraday Soc., Trans.* 30. *pp.* 377–386, *April,* 1934.—The dielectric constants of liquid and solid ethyl behenate have been measured. It was found that both the α and β forms, previously recognised by difference of X-ray long spacing, show phase changes which are accompanied by changes in the rate of expansion of the crystal lattices. The magnitude of the polarisation of the α form suggests freedom of movement of the ester group while in the β form it is fixed. A. S. C. L.

2163. Dielectric Constant, Conductivity and Thermal Hysteresis of Aqueous Solutions of Gelatin. A. and B. Piekara. *Comptes Rendus*, 198. *pp.* 803–805, *Feb.* 26, 1934.—The dielectric constant, ϵ, and conductivity, κ, of solutions of gelatin (" for emulsions," electrodialysed for 2–3 days at 0°) were determined for concentrations of 0·81—1·2 % at 0°—40°, with frequency 10^6/sec. ϵ for a solution of gelatin is always $>$ that for water, and increases with increasing concentration ; the difference from that of water increases with temperature ; both ϵ and κ of the sol are $>$ those of the gel under similar conditions. Both show thermal hysteresis. [See Abstract 2854 (1929.] C. A. S.

2164. Dielectric Constants of Polar Solutions. J. Wyman, Jr. *Am. Chem. Soc., J.* 56. *pp.* 536–544, *March*, 1934.—An account is given of measurements of the dielectric constant of solutions of several ampholytes forming *zwitter* ions, in a variety of solvents. The results indicate in a rather surprising way that in all these cases the dielectric constant is nearly an additive property of the solutions. A discussion is given of a possible interpretation of this in terms of the internal field, which, if valid, would allow of approximate estimates of polarisations and electric moments in the case of polar solutions. H. H. Ho.

2165. Dipole Moment of Acetic Anhydride and Some Anomalies of the Fatty Acid Series. A. and B. Piekara. *Comptes Rendus*, 198. *pp.* 1018–1020, *March* 12, 1934.—Following the difficulties of measuring the electric moment of gaseous acetic anhydride [see Abstract 4647 (1933)], a calculation is made by two methods from the extrapolated value of the polarisation of the non-associated molecules obtained for the substance dissolved in CS_2. Measurements were also made, from the dielectric polarisation in hexane solution, of the dipole moment of acetic and propionic acids, and these showed the anomalies that the molecular polarisation increases with the concentration and temperature. N. M. B.

2166. Induction in the Benzene Molecule. E. Næshagen. *Zeits. f. phys. Chem.* 25. *Abt.B.* 1–2. *pp.* 157–160, 1934.—By means of dipole moment measurements on simple substituted diphenyl derivatives (*o*-, *m*-, *p*- nitro-, *o*- and *p*-chloro- and *o*- and *p*-amido-diphenyl) it is shown experimentally that the benzene molecule must possess induction since in each case the moment of the *para* substituted diphenyl derivative is greater than the moment of the corresponding mono-substituted benzene derivative which in turn is greater than each of the other diphenyl derivatives. W. R. A.

2167. Capacity of Non-Polarisable Electrode with A.C. N. Thon. *Comptes Rendus*, 198. *pp.* 1219–1221, *March* 26, 1934.—With an arrangement similar to that of Jones and Josephs [see Abstract 2816 (1928)] the capacity, C, of Hg electrodes in 0·5 M. $HgNO_3$ is shown to vary as $1/\omega^2$ if the frequency, ν, is $>$4200/sec. (ω being the pulsatance, $= 2\pi\nu$). In 0·1 *M* $HgNO_3$ it varies as something between $1/\omega^2$ and $1/\omega$, approaching $1/\sqrt{\omega}$ as the concentration of Hg- ion further diminishes. In 2 *M* KNO_3 it varies as $1/\sqrt{\omega}$. These results disagree with some earlier ones [see Krüger, Abstract 3138 (1904)]. C appears to increase with depolarisation. [See Abstract 1455 (1932)]. C. A. S.

2168. Influence of Dissolved Gases on the Behaviour of Mineral Insulating Oils. E. B. Baker. *Frank. Inst., J.* 217. *pp.* 373–374, *March,* 1934.—Using data given by Clark [see Abstract 2029 (1933)] the author calculates the diffusion constants for the deaërated transformer oil, using the assumption that convection currents were absent. Since high values are obtained it is concluded that some convection must have occurred. A. M-T.

See also Abstracts 1878, 1879, 2045, 2224, 2190, 2196, 2241.

ELECTROCHEMISTRY.

2169. Physical Characterisation of Dissolved Ions. J. Lange. *Zeits. f. phys. Chem.* 168. *Abt.A.* 2–3. *pp.* 147–187, 1934.—In their thermodynamic and kinetic behaviour (electrical conductivity), the complex NR_4^+ ions exhibit a distinct individuality, in marked contrast to the more or less uniform behaviour of other ions, such as those of the alkali metals, which in aqueous solution are to be regarded as aquo-complexes. The results are given of exact measurements of the freezing point and conductivity of very dilute solutions of various tetralkylammonium halides under rigidly controlled conditions. These results indicate that the individuality of such salts cannot be related to variation in the chemical dissociation, but must be attributed to physical differences of the ions. Such physical differences are incapable of interpretation by any theoretical considerations yet advanced. Details are given of the methods of measurement. T. H. P.

2170. Electrolysis of Fused Electrolytes. P. Drossbach. *Zeits. f. Elektrochem.* 40. *pp.* 180–182, *April,* 1934.—The theory of electrolysis is discussed from the standpoint of decomposition potentials, polarisation and current yield. The effects of the evolution of gas at the electrodes are considered. It is shown that in the case of fused electrolysis the decomposition potential and the polarisation are not identical as in water solutions. F. J. B.

2171. Mobility of Metallic Ions in Alkali Halide Crystals. S. Arzybysev and A. Toporec. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 1. 4. *pp.* 176–178, 1934. *In German.*—In the additive coloration of rock-salt by diffusion of metallic ions into a crystal under the action of an electric field a small vivid red cap appears beyond the limit of the coloured region near to the anode. This cap is separated from the coloured region by a clear region which absorbs ultra-violet light beyond 2000 Å. It is shown that the small cap is caused by diffusion of metallic ions from the anode into the crystal; these ions disturb the crystal grating and permit coagulation of the colour centres in such a way as to cause them to absorb in two band regions with maxima at 465 $\mu\mu$ and 560 $\mu\mu$. With a copper anode measurement of the distance from the anode at which the cap is formed in a given time enables one to determine the mobility of copper ions in rock-salt crystals. This is found to be 130 $\mu\mu$ per second. The mobility of Ag, Fe and Ni ions is similarly determined. J. E. K.

2172. Silver Chloride Electrode Suitable for Use in Dilute Solutions. A. S. Brown. *Am. Chem. Soc., J.* 56. *pp.* 646–647, *March,* 1934.—A simple and rapid electrolytic method is described for preparing AgCl electrodes by initial deposition of Ag from $KAg(CN)_2$ and subsequent chloridisation by electrolysis in 0·1 *N.* HCl. The electrodes are unaffected by sunlight, and their stability and reproducibility are within a few hundredths of 1 mV, even in very dilute solutions. Tests and properties of the electrodes are discussed. N. M. B.

2173. Pb-Cu Cell. (Miss) M. Quintin and A. Lebettre. *Comptes Rendus*, 198. *pp.* 1140–1141, *March* 19, 1934.—Comparison of the normal potentials of the cells (1) [− Pb (amalgam 2 phases) | $PbSO_4(s)$|$CuSO_4(c)$| Cu(amalgam 2 phases) +] for $c = 0\cdot105$–$0\cdot00105$, and (2) [− Cu (amalgam 2 phases) | $CuSO_4(c)$ | $Hg_2SO_4(s)$ | Hg +] shows that the irregularities in (2) when c is $< 0\cdot0030M$ are due to the solubility of Hg_2SO_4. Similar irregularities are exhibited by (1) if c is $< 0\cdot001M$. [See Abstract 2580 (1933).] C. A. S.

2174. Periodic Variation of the Potential of Iron in Chromic-Sulphuric Acid Solutions. M. Karschulin. *Zeits. f. Elektrochem.* 40. *pp.* 174–180, *April*, 1934.—The variation of the potential of iron was measured in chromic-sulphuric acid solutions. It was found that for constant concentration of chromic acid, the frequency and the amplitude of the variations of potential were dependent upon the concentration of the sulphuric acid. The source of the variations of potential of iron in chromic-sulphuric acid solutions was considered to be due to the diffusion of the chromic acid through a layer of ferrous sulphate-liquid which adhered to the surface of the iron. F. J. B.

2175. Calculation of Dissociation Constants from Electrometric Acid Titration. E. Söderbäck. *Arkiv f. Kem. Min. och Geologi, Stockholm*, 11 *A*. 8. [48 *pp*.], 1934. *In German.*—The bulk of the present communication (which is not suitable for abstraction) consists in an attempt to develop a method of calculating dissociation constants free, theoretically, from objection. T. H. P.

See also Abstracts 1772, 1773, 1878, 1879, 2167.

ELECTRONS, POSITRONS AND PROTONS.

2176. Diffusion and Absorption of Positrons Traversing Matter. J. Thibaud and F. D. la Tour. *Comptes Rendus*, 198. *pp.* 805–808, *Feb.* 26, 1934.—Using the same method as with Pt with screens of 17 other elements the range of positrons is equivalent to a passage through matter amounting to 500 mg./cm.^{2}. μ/ρ is approximately constant $= 8\cdot5$. The same value is obtained by a similar method for negative electrons. Both positive and negative electrons behave similarly until the positrons, after losing most of their kinetic energy, begin to dematerialise. [See Abstracts 1318 to 1320 (1934).]. C. A. S.

2177. The Positron. C. D. Anderson. *Nature*, 133. *pp.* 313–316, *March* 3, 1934. *Naturwiss.* 22. *pp.* 293–296, *May* 11, 1934. *Paper read before the Am. Phys. Soc.*—A brief historical survey of the early experimental work on positrons and their production, followed by a discussion of experimental evidence bearing on a recent theory which postulates the creation of a free positive-electron pair out of the absorption of a photon impinging on a nucleus. The experimental evidence quoted includes new statistical studies of the effect of filtered ThC″ γ-rays on Pb and Al, and new experiments on cosmic ray showers carried out by the author and others. W. E. P.

2178. Physical Properties of the Positron. J. Thibaud. *Ann. Soc. Sci. de Bruxelles*, 54. *pp.* 36–52, *March* 20, 1934.—In a review of the properties of the positron, a description is given (1) of the author's method of focussing charged particles by means of a non-uniform magnetic field, (2) of measurements of the specific charge of the positron made by a study of their electrostatic deflection, and (3) of a study of the γ-radiation excited by positrons and which is ascribed to their annihilation. J. E. R. C.

2179. Infinite Distribution of Electrons in the Theory of the Positron. P. A. M. Dirac. *Cambridge Phil. Soc., Proc.* 30. *pp.* 150–163, *April* 30, 1934.—A mathematical discussion in which the author concludes that a precise meaning can be given to the distribution of electrons in which every state is occupied, and also to a distribution of electrons in which nearly all of the negative-energy states are occupied and nearly all of the positive-energy ones unoccupied. J. J. S.

2180. Distribution in Angle of Protons Projected by Neutrons. N. Dobrotin. *Comptes Rendus de L'Acad. des Sciences, U.S.S.R.* 1. 4. *pp.* 179–181, 1934. *In English.*—Protons were ejected from a paraffin wax sheet 23 × 6 × 1 mm. placed in an expansion chamber, when the former was subjected to bombardment by an approximately parallel beam of neutrons (Rn + Be source). The angles at which 77 protons were ejected were determined visually on a ground glass screen. The results agree better with those of Kurie [see Abstract 4858 (1933)] than with those of other previous workers. F. C. C.

2181. Distribution of Protons Produced by Neutron Bombardment. G. Monod-Herzen. *J. de Physique et le Radium,* 5. *pp.* 95–96, *Feb.,* 1934.—A large number of tracks produced in an expansion chamber by neutron bombardment have been examined and curves showing their angular distribution are given. It is claimed that these clearly demonstrate the existence of two groups of protons. The directions of the fast group are distributed about an angle of 45° to the direction of the incident neutron; in the case of the slow group this angle is about 70°. J. E. R. C.

2182. Electron Diffraction by Cellulose Films. J. J. Trillat. *Comptes Rendus,* 198. *pp.* 1025–1027, *March* 12, 1934.—The author has succeeded in producing electron diffraction effects, visible in daylight, with thin crystalline films of various cellulose compounds, of thickness 50–100 Å. The existence of single crystals in parts of the films is established. The process of crystallisation can be followed. The cellulosic chains in the cellulose esters are arranged parallel to one another, and lie along the surface of the film. The atoms of the chains are situated at the intersections of a rectangular network, the sides of the rectangle having the values 7·10 Å and 4·68 Å. The thickness of the mesh is 2·5 or 5·0 Å, and the network is probably monoclinic in character. J. S. G. T.

2183. Diffraction of Electrons in the Halogens. F. L. Arnot. *Roy. Soc., Proc.* 144. *pp.* 360–377, *March* 29, 1934.—The angular distribution of the elastically scattered electrons in the vapours of I_2, Br_2, $CHBr_3$ and CCl_4 has been measured for several different energies of the incident electron beam. Diffraction effects are observed in all the curves. The curves for I_2, Br_2 and CCl_4 are similar respectively to the curves previously obtained by the author for Xe, Kr and A. The curves for $CHBr_3$ show the same diffraction structure as do those for Br_2. These results, together with some previous results obtained by the author and other investigators, are then discussed from the theoretical standpoint. Evidence is put forward to show that at large angles the shape of a scattering curve for any energy up to the energy at which the Born approximation is valid depends upon the first few harmonics, and that in light atoms, where the phases of low order are well separated in magnitude, the form of the curve is given approximately, over the whole of the above range of energies, by the harmonic whose associated phase has a value most nearly equal to $\pi/2$. AUTHOR.

2184. Electron Diffraction by Powdered Crystals. F. Trendelenburg and O. Wieland. *Wiss. Veröff. a. d. Siemens-Konzern,* 13. 1. *pp.* 41–47, 1934.—An electron camera is described which is suitable for the study of powders. A narrow beam of electrons (30 kV) impinges on a brass disc; a ring shaped slit is cut in the disc and across it run a number of spider webs. The powder, in suspension, is deposited on the spider webs. giving an extremely thin coating. Sharply defined diffraction rings are obtained with exposures of a few seconds which enable the grating spaces to be obtained accurately (probable error about 0·25 %). Examples of diffraction rings for a number of common substances are given. H. J. H. S.

2185. Sector Method for Reducing the Dark and Diffuse Background in Electron Diffraction Photographs. F. Trendelenburg and E. Franz. *Wiss. Veröff. a. d. Siemens-Konzern,* 13. 1. *pp.* 48–54, 1934. —A negative is made of the original plate which is to be improved but, during the process of copying, the exposure is varied from the centre of the plate to the edge in such a way as to give a uniform background. A sector is used for this purpose and is rotated between the source of illumination and the negative. The form of the sector is simple and can readily be calculated. A print or positive plate may then be taken with the negative. The precautions to be observed if photometric measurements are to be made on this positive are mentioned. H. J. H. S.

2186. Determination of Inner Potentials of Crystals by Kathode Ray Reflection. Part II. T. Yamaguti. *Phys. Math. Soc., Japan, Proc.* 16. *pp.* 95–105, *March,* 1934. *In English.*—The inner potential of molybdenite, zincblende, graphite and talc are determined fairly accurately from the reflection spectra of kathode rays due to the cleavage faces of these crystals. The values obtained are 17·09, 12·68, 11·48 and 11·97 volts respectively. An anomaly observed at the reflection of small glancing angles is explained by the deviation of the inner potential at the crystal boundary from the normal value at the interior. It is also suggested that inconsistent values of the inner potentials obtained by some authors using slow electrons may be attributed to the same anomaly of the inner potential at the crystal boundary. [See Abstracts 2094 and 2984 (1932).] AUTHOR.

2187. Polarisation of Electrons in Free Atoms. E. Rupp. *Zeits. f. Physik,* 88. 3–4. *pp.* 242–246, *March* 19, 1934.—Rapid electrons of 20 to 160 kV were scattered twice at 90° [see Abstracts 2558 (1932) and 1192 (1933)] by Tl vapour, and thereby an unsymmetrical reflection in the sense of a polarisation of the electrons was established. The increase of polarisation with ray velocity is discussed from the standpoint of Mott's theory [see Abstract 2983 (1932)]. H. H. Ho.

See also Abstracts 1791, 1792, 1795, 1797, 1872, 1876, 1997, 1998, 2138.

ELECTROSTATICS.

2188. Electrostatic Voltmeter. A. Palm. *Zeits. f. techn. Physik,* 15. 3. *pp.* 117–119, 1934.—A small electrostatic voltmeter is described which has a linear scale and potential range of about 150 volts, and a small capacity. It is suitable for h.f. tension measurements and the results of its examination when tested in h.f. work are given. J. J. S.

See also Abstracts 1849, 2151.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

2189. Possible Effect of Axial Orientation on the Magnetic Transition Figure. W. J. de Haas, J. Voogd and J. M. Jonker. *K. Onnes Lab., Leiden. Comm. No.* 229*c. Physica,* 1. *pp.* 281–290, *Feb.,* 1934. *In German.*—An extension and more exact repetition of a previous research [see Abstract 2774 (1931)]. The material consisted of various single-crystal tin wires in which the axes of figure made different angles with the tetragonal axis. The transition figure was drawn by plotting the resistance ratio R/R_0 with the corresponding variable whether temperature or field. When the resistance is measured at a given temperature in an increasing transverse field, the axial direction has no apparent effect on the change from supraconductivity to the normal state. Further, the strength of current applied to the wires in making the measurements has no effect on the end values of R/R_0, but it affects the course of the transition figure between these end values. For a wire of elliptical section, the course of the figure depends on the angle between the major axis and the transverse magnetic field. The transition curve in a constant field with variable temperature shows close agreement with that found when the temperature is constant and the field varies. G. E. A.

2190. Penetration of a Supraconductor by a Transverse Magnetic Field. W. J. de Haas and J. M. Casimir-Jonker. *K. Onnes Lab., Leiden, Comm. No.* 229*d. Physica,* 1. *pp.* 291–296, *Feb.,* 1934. *In German.* —A thick monocrystal wire of tin was made, containing three glass capillaries, one along the axis, and the others near the edge and parallel to the axis. Bi wires were inserted in the capillaries and their resistances measured, giving a quadratic curve for R/R_0 and H. The tin cylinder was then cooled below the temperature at which supraconduction begins, and a transverse field was applied and increased by steps until supraconduction had disappeared. The change of resistance of the Bi wires gave information of the changes of the magnetic field in the tin cylinder. The resistance of the Bi wires is not changed from the normal until the external field attains a value which is greater for the middle wire than for the outer ones. Also, the form of the curve of resistance change as a function of the applied field differs widely from that for the normal change of a Bi wire in a magnetic field. It is inferred that with the application of the field, persistent currents arise which compensate the change of the field in the interior of the supraconductor. With a given field supraconduction is destroyed at the exterior, the persistent currents die away, and the field undergoes a great change at these places. Gradually the field penetrates to the axis. G. E. A.

2191. Effect of Direction of Spontaneous Magnetisation on Resistance. D. S. Steinberg and F. D. Miroschnitschenko. *Phys. Zeits. d. Sowjetunion,* 5. 2. *pp.* 241–252, 1934. *In German.*—The effect of change of direction of spontaneous magnetisation on the resistance of Ni, Fe and Ni-Fe alloys was investigated, the direction of spontaneous magnetisation being found from the direction of the elastic deformation employed. The change of resistance expected from theory was observed during the elastic stretching and torsion of wires of pure Fe and Ni and for an alloy of Fe with 15 % of Ni . [See also Abstract 4040 (1932)].

G. E. A.

2192. Crystal Structure and Electrical Properties. Part IV. Conductivity Surfaces of Bi Crystal. O. Stierstadt. *Zeits. f. Physik,* 87. 11–12. *pp.* 687–699, *Feb.* 19, 1934.—The resistance surface (surface whose radius vector in any direction equals the specific resistance in that direction) of a bismuth crystal in the absence of a magnetic field, consists of an ellipsoid of rotation with its axis of rotation parallel to the main axis of the crystal. On application of a magnetic field in a given direction with respect to the crystal axes, the resistance in all directions is modified, and it is the object of this work to determine the form of the modified resistance surfaces making use of the experimental data previously obtained [see Abstract 363 (1934)]. Confining attention to the special case in which the magnetic field is applied in the direction in which the resistance is being measured, the resistance surface is derived. A plane section of the surface, through the principal axis gives a curve deviating appreciably from an ellipse, and a section at right angles to the principal axis, gives a curve exhibiting the six-fold rotational symmetry possessed by the crystal lattice of bismuth. A further complication is that the form of the surface varies with the intensity of the applied magnetic field. W. S. S.

2193. Magneto-Thermoelectric Effects in Nickel and Iron. A. Perrier and (Miss) T. Kousmine. *Comptes Rendus*, 198. *pp.* 810–812, *Feb.* 26, 1934.—The differences, ΔE, between the thermoelectric power of couples consisting of a non-magnetic metal and nickel or iron unmagnetised, and of couples consisting of the same metal and Ni or Fe magnetised, $\parallel$ and $\perp$ to the direction of the temperature gradient are plotted against the strength of the magnetising field ($H=55\cdot5-1300$ gauss). ΔE is positive, indicating increase in thermoelectric power as a result of magnetisation, or negative, indicating decrease, according as H is $\parallel$ or $\perp$, and much greater when it is $\parallel$. In Ni the curves rise with increasing field almost hyperbolically to a saturation limit; in Fe they attain a maximum and then decline, also towards a limit. [See Abstract 233 (1931) and following Abstract.] C. A. S.

2194. Magneto-Thermoelectric Effects in Nickel and Iron. A. Perrier and (Miss) T. Kousmine. *Comptes Rendus*, 198. *pp.* 920–921, *March* 5, 1934.—The thermoelectric anisotropy, $\Delta E \parallel - \Delta E \perp$, $43\cdot7\times10^{-8}$ volt/° C. for Ni and $14\cdot8\times10^{-8}$ for Fe, as deduced from previous results, represents the mean spontaneous thermoelectric anisotropy of the elementary saturated groups. Both $\Delta E \parallel$ and $\Delta E \perp$ are intrinsic properties of the metals, and independent of contact potential; the ratio $\Delta E \parallel / \Delta E \perp$ is $-2\cdot2$ for Ni and $-1\cdot8$ for Fe, in fair agreement with -2 as required by the authors' theory; as also is the fact that there is no simple relation between ΔE and the intensity of magnetisation. [See preceding Abstract.] C. A. S.

2195. Thermomagnetic Study of an Austenitic Fe-Ni-C-Cr Alloy. P. Chevenard. *Comptes Rendus*, 198. *pp.* 1144–1146, *March* 19, 1934.—The heterogeneity produced in an Fe-Ni-C-Cr alloy by precipitation of the carbide (rich in Cr) is examined by a magnetic method. Magnetisation-temperature curves show the effect of this heterogeneity and its variation with thermal treatment. A quantitative measure of the heterogeneity for a given thermal treatment is obtained by a graphical method. H. J. H. S.

2196. Resistance of Manganese Arsenide. L. F. Bates. *Phil. Mag.* 17. *pp.* 783–792, *April*, 1934.—The variation with temperature of the resistance of manganese arsenide has been determined, using a method suitable for measurements with specimens in the form of short brittle rods.

The connection between the observed resistance changes and changes in the energy of spontaneous magnetisation is discussed. AUTHOR.

See also Abstract **2103.**

MAGNETISM AND ELECTROMAGNETISM.

2197. Magnetised Ellipsoids and Shells in a Permeable Medium. L. R. Wilberforce. *Phys. Soc., Proc.* 46. *pp.* 312–317, *May* 1, 1934.—The relation between the magnetic fields round a uniformly magnetised ellipsoid when in a vacuum and when immersed in a permeable medium is investigated. The probability that the field round a thin normally magnetised shell is independent of the permeability of the medium surrounding it is discussed. [See Abstract 1639 (1933).] AUTHOR.

2198. Displacement of Curie Point with Concentration in Austenitic Ferro-Nickels. A. Portevin, E. Pretet and H. Jolivet. *Comptes Rendus*, 198. *pp.* 1141–1144, *March* 19, 1934.—The reversible Ni-Fe alloys which have a sufficient W or Mo content are extremely resistant to the action of HCl. This resistance depends chiefly on the concentration of the W or Mo in the austenitic phase; the concentration varies with temperature and thermal treatment. Precipitation of the W-rich phase may occur; an examination of the variation of the coefficient of expansion and the change in magnitude and position of the Curie point of the γ-phase for a number of alloys illustrates the nature and resultant effects of this precipitation. H. J. H. S.

2199. H.F. Permeability of Ni and Fe. J. Müller. *Zeits. f. Physik*, 88. 3–4. *pp.* 143–160, *March* 19, 1934.—A thermal method of measuring the h.f. resistance of wires is given. The apparatus is tested by measuring the effective resistance of a Pt wire and checking the results obtained by the skin effect formula. The effective resistance of Ni and Fe wires for various wave-lengths between 4 and 10 m. and for various degrees of magnetisation is measured and the effective permeability deduced and its relation to the wave-length derived. There are no irregularities or anomalies (of magnitude greater than 3 %) in this region. For Ni, the frequency has no effect on the effective permeability for different degrees of magnetisation, whilst for Fe the effective permeability decreases with increasing frequency, the decrease being greater for weaker magnetisations. H. J. H. S.

2200. Large Barkhausen Discontinuities and Their Propagation in Ni-Fe Alloys. R. E. Reinhart. *Phys. Rev.* 45. *pp.* 420–424, *March* 15, 1934.—The velocity of propagation of large Barkhausen discontinuities has been investigated as a function of circular field, longitudinal field, torsion and tension for a cold-drawn 10 % Ni-Fe alloy wire of 0·0334 cm. dia. Curves relating velocity of propagation and circular field were found to be similar to curves relating velocity of propagation and longitudinal field, thus suggesting similar functional relationship in the two cases. These relationships were explained when it was found by two different experimental studies that only the component of the resultant field, impressed on the wire, in the direction of the principal strain axis of elongation is important in determining the velocity of propagation. The component perpendicular to this direction of maximum elongation produces no appreciable effect on the velocity. A method of heat treating 70 % Ni-Fe alloy wire 0·0321 cm. in diameter has been developed which made it possible to investigate the relationship between velocity of propagation and longitudinal field over much greater ranges of field and velocity than was possible for untreated wire. Over a range of field strengths of 2·23 oersteds the velocity was observed to vary from 1000 cm. sec.$^{-1}$ to 140,750 cm. sec.$^{-1}$. The relationship between velocity and field for this wire is definitely not linear. Discontinuities in which the change in induction was accurately equal to the total change in induction between saturation in the two directions were observed for these heat treated wires. AUTHOR.

2201. Interaction Between Magnetogenic Atoms in Paramagnetic Crystals. H. A. Kramers. *Physica,* 1. *pp.* 182–192, *Jan.,* 1934. *In French.*—The magnetogenic atoms in a crystal of a paramagnetic salt may be considered, in the first approximation, to be free, *i.e.*, the direction of the magnetic moment of an atom is not affected by that of the surrounding atoms. The nature of the weak forces of interaction which might destroy this freedom is studied. Their effect may become sensible at very low temperatures. It is assumed that all magnetic atoms are in a doubly degenerated state. This condition obtains in a large number of salts of the rare earths, but a generalisation is required before applying certain considerations to those cases in which the magnetisation of the atom is due to a free vector spin [$s=1, 3/2 \cdots$ *e.g.*, salts of Gd, $s=7/2$; chromic and ferric salts, $s=3/2$.] G. E. A.

2202. Paramagnetism of Rare Earth Ions. C. J. Rodden. *Am. Chem. Soc., J.* 56. *pp.* 648–649, *March,* 1934.—Using the Gouy method, measurements of magnetic susceptibility at room-temperature were made for the compounds, $Pr_2(SO_4)_3\cdot 8H_2O$, $Nd_2(SO_4)_3\cdot 8H_2O$, Nd_2O_3, $Nd\ Fe(CN)_6\cdot 4H_2O$, $Sm_2(SO_4)_3\cdot 8H_2O$, Sm_2O_3, and $Yb_2(SO_4)_3\cdot 8H_2O$. The results are discussed with reference to van Vleck's theory of paramagnetism and are found to be in general agreement therewith. N. M. B.

2203. Magnetism of B_2H_6. L. Farkas and H. Sachsee. *Faraday Soc., Trans.* 30. *pp.* 331–333, *March,* 1934.—The effect of B_2H_6 on the para-ortho hydrogen conversion has been studied to decide whether it is paramagnetic. At 195° K. it has no effect, and is therefore diamagnetic; but it is suggested that there may exist a paramagnetic excited level, the energy of which could be found. A. S. C. L.

2204. Magnetism of Hydrated Thoria. F. Bourion and (Miss) D. Beau. *Comptes Rendus,* 198. *pp.* 916–918, *March* 5, 1934. The magnetic susceptibility of hydrated thoria varies linearly with the content of water; it is therefore a mixture and not a true hydroxide. [See Abstract 985 (1929).] C. A. S.

2205. Magnetic Properties of Liquid O_3 and of Liquid ($O_3 + O_2$) Mixtures. P. Lainé. *Comptes Rendus,* 198. *pp.* 918–919, *March* 5, 1934.—Determined by similar methods [see Abstract 3231 (1933)] the magnetic susceptibility of liquid O_3 at temperatures near that of liquid air is about $1\cdot 5\times 10^{-7}$, and its thermal variation $< 1/3$ of that required by the Curie law. The thermomagnetic method of determining the amount of O_2 is verified. By maintaining a vacuum above an agitated mixture of liquid O_2 and O_3, liquid O_3 containing under 0·01 % O_2 can be obtained. C. A. S.

2206. Magnetic Susceptibilities of Gases and Vapours. S. R. Rao and G. Sivaramakrishnan. *Phys. Soc., Proc.* 46. *pp.* 318–323, *Disc.,* 323, *May* 1, 1934.—A new method of determining experimentally the magnetic susceptibilities of gases and vapours is described. Compensation is effected for the test bulbs, and the influence of surface condensation, if any, of gases and vapours can be allowed for and separately investigated. Electromagnetic retorsion is employed and the arrangement is rendered independent of small changes in the magnetising current. The molar susceptibility of CO_2 was found to be $-(20 \cdot 79 \pm 0 \cdot 08) \times 10^{-6}$, showing good coincidence with the values of other investigators. The arrangement is being improved in several directions to give much greater accuracy. A systematic investigation of many gases and vapours will then be undertaken

AUTHORS.

2207. Rotational Magnetic Effects. S. J. Barnett. *Phys. Zeits.* 35. *pp.* 203–205, *March* 1, 1934.—Two effects are commonly known: (1) Magnetisation by rotation (Barnett effect), and (2) Rotation by magnetisation (Einstein and de Haas effect). Each of these phenomena may be regarded as the inverse of the other. The question arises as to priority of publication and discovery. The present note reviews the position and claims priority for the Barnett effect. The details also trace the history of the whole subject, and state that Einstein and de Haas were in no way aware of the author's early work on the subject. [See following Abstract.]

S. G. B.

2208. Rotation of Cobalt and Nickel by Magnetisation and the Gyromagnetic Ratios of their Magnetic Elements. S. J. Barnett. *Am. Acad., Proc.* 69. 2. *pp.* 119–135, *Jan.* 1934.—The work recorded on soft iron and permalloy [see Abstract 3943 (1931)] has now been extended to nickel and cobalt, using the same type of apparatus and similar technique. The results so obtained are in complete accord with those obtained by L. J. Barnett and the author in their work on magnetisation by rotation. In that work they give the mean value for ρ for all ferromagnetic substances investigated as $1 \cdot 059$ m/e. The present work, on the converse effect gives values for iron as $1 \cdot 037$, permalloy $1 \cdot 049$, nickel $1 \cdot 059$, and cobalt $1 \cdot 077$, giving a mean value for the series of $1 \cdot 055$ m/e. The agreement is excellent. Full experimental details are given. [See preceding Abstract.]

S. G. B.

2209. Demonstration of Paramagnetism and Diamagnetism in Fields of Low Intensity. A. O. Rankine. *Phys. Soc., Proc.* 46. *pp.* 391–403; *Disc.*, 403–407, *May* 1, 1934.—The instrument is a means of demonstrating in a convincing manner the paramagnetism or diamagnetism of substances of small susceptibility, *e.g.*, the diamagnetism of a few c.c. of water. The magnetising fields employed are much smaller than has hitherto been customary, being of the order of 50 gauss or less. This first model of the instrument is imperfect in certain respects, mainly on account of the use of some brass in the construction. The objections to this material, on account of its ferromagnetic content, were not at first realised, and it will be necessary to construct a new apparatus, employing carefully chosen materials, before full advantage can be taken of the sensitivity available. It seems certain that gases also may be brought within the scope of accurate determination. The system used also provides a basis for the construction of a new form of very sensitive galvanometer, and this matter is discussed briefly.

AUTHOR.

2210. Circuit Doubler for Use with a Dotting Recorder. H. E. Beckett and H. Sheard. *Journ. Sci. Instruments,* 11. *pp.* 111–113, *April,* 1934.—A special switch is described which enables twelve simultaneous records to be obtained on a six-point recorder. The doubling of the available number of circuits is useful when the quantities to be recorded are not subject to rapid fluctuations.

AUTHORS.

2211. Duplex Commutator and Key of Small Thermo-E.M.F. O. Kantorowicz. *Journ. Sci. Instruments,* 11. *pp.* 116–118, *April,* 1934.

—The construction of a duplex commutator and key of small thermo-e.m.f. is given in detail. The switch is designed to short-circuit the galvanometer during commutation instead of disconnecting it in the more usual way. The complete device is contained in one casing and is operated by turning a single handle through a right angle. AUTHOR.

See also Abstracts 1870, 1871, 1984, 1985, 2103.

MEDICAL RADIOLOGY AND ELECTROLOGY.

2212. Medical Applications of H.F. Oscillations. W. Holzer. *E.u.M.* 52. *pp.* 121–127, *March* 18, 1934.—The development and use of the therapeutic applications of h.f. oscillations are briefly reviewed. The apparatus utilised is described in respect to construction and operation. Difficulties of exact measurements of short-wave radiation are mentioned, and the methods adopted are discussed. The wave-length region utilised is considered, and the action of the radiation entered into, on the basis of the Debye theory. It is shown that, in the range of these short waves, special phenomena occur which are partly explained by the dipole theory. Numerical examples indicate that the resonance of ions with wave-length, as developed in respect to electrolytes, gives reasonable agreement with the clinical effects. The necessity of developing accurate methods of measurements in therapeutic applications is expressed. B. J. L.

2213. Efficiency of X-Ray Stereoscopy, as Influenced by the Method of Trip of the Tube. P. M. Andrus and A. Hambleton. *Radiology,* 22. *pp.* 174–180, *Feb.,* 1934.—In a previous paper the authors have discussed the resultant sharpness of X-ray photographic images, in relation to the position of the X-ray tube. It was shown that a saving in energy *via* the tube up to 22 % may be obtained by correct position. These findings related to single exposures only, whereas the present paper relates to stereoscopic exposures, with the object of obtaining maximum sharpness. The geometrical principles are analysed, together with the relative efficiency of methods of stereoscopic tube shift. The best result is obtained by shifting the tube in its own lateral axis along the long axis of the film, while, at the same time, the tube is rotated so that the central ray is in each case projected to the centre of the object to be radiographed. Stereoscopic agreement is 3 % better when the tube is so rotated than without tube rotation. This improvement is, however, without the range of visual appreciation, so that it is impractical, for this small benefit, to incur the necessary mechanical difficulties in movement of the tube. Failure correctly to centre the tube for stereoscopic exposures results in greater distortion and non-definition of the film image than in single film exposures and these defects are greater with line focus tubes, than with those tubes with the simple 45° anodes. B. J. L.

2214. Focal Spot Camera. P. C. Hodges. *Am. J. of Roentgenology and Radium Therapy,* 31. *pp.* 399–405, *March,* 1934.—The focal spot of an X-ray tube is defined as the surface area of the anode or target, upon which the kathode stream is focussed. It has been shown that the definition of X-ray tubes is modified by emission of X-rays, owing to the electronic stream falling upon the anode head, or stem, beyond the focal spot. The effective focal spot is defined, reference being made to the line-focus principle. Investigation and measurement of the focal spot area, by means of the simple pin-hole camera, modified for X-ray purposes, is described. This simple camera entails exact knowledge of the distance of the focal spot from the camera, which is not always possible if the X-ray tube is built into other apparatus and cannot be removed. To overcome this difficulty the author has devised a camera, utilising three pin-holes, but otherwise of simple design. B. J. L.

2215. Design of X-Ray Apparatus. A. Bouwers. *Radiology*, 22. *pp.* 163–173, *Feb.*, 1934.—A review of recent new designs of X-ray apparatus, as developed in the Philips X-ray Research Laboratory at Eindhoven. Recent research has permitted exposure times, with stationary tube anodes, to be reduced by automatically altering the filament resistance during exposure, the principle of the method being explained, which may also be applied for the automatic control of the load of the tube. The recent development of a shock-proof protective tube, in which the anode is rotated as an induction motor, so that a continual change of target surface with resulting better cooling and increase loading is obtained, is also described, together with mercury-vapour h.t. rectifiers, which replace, with space economy, the more usual electronic valve rectifiers, with the advantage of reduced voltage drop across the valve. A novel apparatus is described, manufactured in two forms for dental and portable radiography, in which the X-ray tube is surrounded by the h.t. transformer, with emission of the X-rays *via* a window in the transformer. The apparatus is shock-proof, and may be held in the operator's hand during operation, the dental apparatus weighing only 12 lb. and the portable apparatus only 17 lb. A new h.t. apparatus, based on the Villard circuit, in cascade connection, utilising the mercury-vapour rectifier is considered, and a practical type of enclosed apparatus, for 400-kV operation, has been developed, and operation at 800 kV has been used, with operation in an ordinary room. By utilising the "principle of limited reach," *i.e.*, consideration of the maximum range of secondary electrons, new types of X-ray tubes have been developed, which permit operation at and above 400 kV. B. J. L.

2216. Continuously Evacuated X-Ray Tube for Deep Therapy. T. E. Allibone and F. E. Bancroft. *Brit. J. of Radiology*, 7. *pp.* 65–82, *Feb.*, 1934.—After a summary of the history of h.t. continuously evacuated X-ray tubes, including one designed to operature from a Tesla transformer giving 380 kV peak, an account is given of a 250 kV tube designed for hospital use. The tube consists of a steel body, protected by lead sheet and provided at each end with flanges lapped optically flat. The antikathode assembly comprises a gold target sealed in a massive copper block, which can be rotated so that the X-ray beam may be directed on any point in a plane normal to the tube. The target is cooled by water from the high-pressure mains, a procedure made possible by the fact that the body of the tube and the target are at earth potential. At the end remote from the antikathode, the body carries a high-grade porcelain insulating cylinder, which, in turn carries the kathode assembly consisting of a steel tube within which is mounted a tungsten filament. The tube is mounted on a plate and can be raised or lowered by means of a motor. The necessary vacuum is maintained by oil-vapour diffusion pumps, backed by a rotary oil pump, which are raised or lowered with the tube. The tube is capable of operating at 200 kV and 10 mA continuously, and the necessary vacuum is obtained (from atmospheric pressure) in about 40 min. [*See also* M.V. Gazette, 14. pp. 371–377, April, 1934.] G. E. B.

2217. 300-kV D.C. Generator using Continuously Evacuated Rectifiers. T. E. Allibone, A. Beetlestone and G. S. Innes. *Brit. J. of Radiology*, 7. *pp.* 83–96; *Disc.* 96–97, *Feb.*, 1934.—The generator employs a Greinacher circuit incorporating a transformer so designed that one pole of the output may be earthed. The two rectifiers are mounted one above the other, the necessary pumping system (of oil-vapour diffusion pumps with rotary backing pump) being located at a point of earth potential. In each of the rectifiers the main insulating jacket consists of a porcelain cylinder. The lower end of the lower rectifier is closed by a steel plate which communicates with the pumps, and the upper end is closed by a steel plate which supports the second rectifier, whose upper end is similarly closed by a steel plate. The various joints are made vacuum-tight by the use of lapped optically flat flanges. As the generator embodies continuously evacuated rectifiers, and is intended for use with continuously evacuated X-ray tubes, a system of automatic control is embodied. A press-switch starts the rotary pumps, and when these have evacuated the rectifiers (or tube) to the required air pressure, heat is applied automatically to the oil-vapour diffusion pumps. After allowing sufficient time for these to operate (10 min.) the various filaments are automatically heated. The only other control is a press switch governing the h.t. transformer. An indicator panel is interlocked with the various supplies to the pumping gear, etc., so that, in the event of a breakdown, the cause of the trouble may readily be located. [*See also* M.V. Gazette, 14. pp. 371–377, April, 1934.] G. E. B.

2218. Gas X-Ray Tube. G. Hägg. *Rev. Sci. Instruments*, 5. *pp.* 117–118, *March*, 1934.—Gives constructional details of a demountable gas-tube capable of operating satisfactorily when passing a current of 10 mA at a voltage of 45 kV. The body of the tube is made of steel, provided with efficient water cooling. The cooling water is led through copper tubes wrapped round the steel body, adequate thermal contacts being established by the use of solder. Special provision is made for cooling the windows and the target. The antikathode consists of a brass cone provided with a copper top to which the target is fixed. It is stated that most metals commonly used as targets may be affixed with tin-solder, while chromium may be affixed by gold, using an ordinary borax flux. Six windows (each 4 mm. dia.) are provided. The kathode is of aluminium screwed to a copper rod, and cooled by radiation pins. The insulating tube may be of Pyrex or Duran glass, and picein is used for vacuum purposes. The size of the focal spot may be varied somewhat by varying the anode-kathode distance and the radius of curvature of the kathode, a convenient setting being a separation of 60 mm. with a radius of curvature of 100 mm. G. E. B.

2219. Comparison of H.T. X-Ray Tubes. L. S. Taylor, G. Singer and C. F. Stoneburner. *Am. J. of Roentgenology and Radium Therapy*, 31. *pp.* 378–385, *March*, 1934.—Relates to comparative tests carried out at the Washington Bureau of Standards, in respect to the emission of X-rays from various types of X-ray tubes, namely: two thin glass-wall tubes, five thick glass-wall tubes and one metal tube. The method of test is diagramatically described and the tubes were operated directly from a transformer with mechanical rectification (utilising 20° of the cycle), by constant potential apparatus, half-wave valve rectification, full-wave valve rectification, and a constant potential apparatus used in the Bureau of Standards, having a very small ripple. The paper largely consists of data in the form of curves and the results show that with constant potential operation a thin wall glass X-ray tube gives 15 % greater output than tubes having a thick glass wall, whilst the metal tube is still less efficient, the latter varying greatly between half-and full-wave rectification at equal peak voltage, although, with any given effective voltage from any type of generator, the output was the same. At any equal given effective (r.m.s.) voltage, the outputs of all glass tubes on all generators, were nearly the same, and equal to the output on a constant potential of the same value. Likewise, at a given effective voltage, the quality (full absorption curve) was the same for all tubes on all generators. B. J. L.

2220. Slit-less Universal Chamber for X-Ray Dosage Measurement. R. Jaeger. *Phys. Zeits.* 35. *pp.* 184–187, *March* 1, 1934.—After showing that " thimble " or spherical chambers of the usual type are unsuitable for the accurate measurement of X-rays having a half-value layer of less than about 0·2 mm. of copper, the author describes a chamber having a long useful range, the error being not very large even in the region of " grenz-rays " (6 kV unfiltered). The chamber is of flat cylindrical form, the flat walls being of cellophane about 0·01 mm. thick, the curved sides of " air wall material " and the inner electrode of graphitised bakelite. The inner electrode is connected to the measuring system through an amber insulator. The chamber was found on test to be comparatively free from quality error, the error for radiation excited at 190 kV and filtered by 1 mm. Cu being + 2·5 %, and that for radiation excited at 40 kV and unfiltered being −0·2 %. Polar curves show that the directional effect is small for the types of radiation commonly used for diagnostic work, superficial and h.t. therapy, but some directional error occurs for very soft (*grenz*) radiation. G. E. B.

2221. Ionisation Produced in Air by X-Rays and γ-Rays. W. V. Mayneord and J. E. Roberts. *Brit. J. of Radiology*, 7. *pp.* 158–175, *March*, 1934.—A parallel plate ionisation chamber and measuring system, suitable for use with h.t. X-rays, are described. Saturation and plate separation conditions were shown to be satisfactory for X-rays up to 370 kV, and apparently so for γ-rays. Measurements of γ-rays in röntgens gave the equivalent of 1 mg. hr. at 1 cm. from a point source as 3·08 r. This result does not agree with previous " air wall " chamber experiments. An investigation of the discrepancy showed that the paths of the recoil electrons were greater than the linear dimensions of the apparatus, and it is shown that the ionisation in a small " air wall " (*i.e.* solid walls of atomic number approximately that of air) chamber is a complex function of conditions, unless the walls are of a thickness at least equal to the ranges of electrons produced by the radiation in them. It is found experimentally that a thick-wall, carbon chamber has an equivalent air volume equal to its real volume for X-rays. Deviations between the parallel plate chamber readings and the carbon chamber appear when the calculated range of the recoil electrons produced in the air exceed the half length of the parallel plate chamber. Measurements of γ-rays in röntgens, using the thick-walled carbon chamber, gave as the equivalent of 1 mg. hr. at 1 cm. from a point source (0·5 mm. Pt filter), 8·3 r. It appears that this result is sufficiently accurate for clinical use, and that a small " air wall " chamber, with sufficiently thick walls, forms a satisfactory measuring instrument for γ-rays, whereas parallel plate chamber of normal dimensions is inadequate. J. E. R.

2222. Absorption of γ-Rays by Barium Sulphate Plaster, Water and Beef. J. S. Rogers. *Brit. J. of Radiology*, 7. *pp.* 176–186, *March*, 1934.—The absorption of the γ-rays from Ra(B+C) in $BaSO_4$ plaster, water, and beef, has been investigated by a photographic method. The results obtained for the absorption of γ-rays in this plaster are compared with those of Kaye, and of Sievert and Thoraeus, for the absorption of X-rays. The thicknesses of plaster for adequate protection against X- and γ-rays are discussed. The emergent intensities of γ-rays for different thicknesses of beef up to 20 cm. have been measured. J. E. R.

2223. Physical Relationship between the Röntgen (r) and the Unit of Radium Dosage "mg.eh/cm." R. Jaeger. *Phys. Zeits.* 35. *pp.* 273–275, *April* 1, 1934.—A consideration of determinations by Eve and later by Reitz of Eve's constant lead to an average value $K=4\cdot28\times10^9$. Using this figure it is possible to calculate the ionisation produced per hour at 1 cm. from a point source of 1 mg. of Ra element, and this may be expressed in röntgens (r), the unit of X-ray quantity. The value obtained for 1 mg.eh/cm. is 7·35 r. This must, however, be regarded as a minimum value, as the value of Eve's constant used applies only to the γ-rays of Ra C, and takes no account of the Ra B-radiations which are usually present in the more lightly filtered medical Ra preparations. The calculated value compares favourably with experimental and calculated values so far published. J. E. R.

See also Abstracts 1967, 2079, 2216, 2217, 2218, 2219.

OSCILLATIONS.

2224. Resonance Frequency of Oscillating Circuits with Leaky Condenser and its Bearing on Measurement of the Dielectric Constant of Ionised Gas. S. S. Banerjee. *Phil. Mag.* 17. *pp.* 834–843, *April*, 1934.—It is shown theoretically that if a leaky condenser has uniform conductivity, the resonance frequency for maximum voltage is equal to that when the space is non-conducting. When, however, the conducting material is not uniformly distributed, as may be represented by two condensers in series, having different resistances in parallel with each, then a more complicated formula for the resonance frequency is obtained. It is shown that an ionised gas in a glass tube conforms to the second case. Experiments are described using the plate filament space of a valve as a conducting condenser, and it is found that the observed resonance frequencies agree fairly well with theory. The conductivity of the ionised gas is the real cause of the apparent increase in dielectric constant often obtained in practice, although excluded at any concentration by Eccles-Larmor theory. H. M. B.

2225. Optical Projection of Valve Characteristics. F. C. Connelly. *Phys. Soc., Proc.* 46. *pp.* 384–389 ; *Disc.*, 390, *May* 1, 1934.—A simple and robust apparatus has been developed, primarily for lecture demonstrations, to show the various characteristic curves of valves on a screen of any desired size. Two mirror oscillographs are employed with axes at right angles, one indicating anode current and the other the grid potential. A suitable alternating voltage of small amplitude from a 50-cycle supply is applied to the grid, causing the characteristic to be traced out 50 times a second, and persistence of vision causes the whole curve to be visible. The instrument indicating current is a Sprenger oscillograph, while the voltage-controlled vibrator is a special instrument designed for the purpose and described in the paper. AUTHOR.

See also Abstracts 2129, 2150, 2151, 2152, 2234.

PHOTOELECTRICITY.

2226. Attempts to Apply the Laws of Photoelectric Emission to Blocking-Layer Photoelectric Cells. G. Liandrat. *Comptes Rendus*, 198. *pp.* 1028–1030, *March* 12, 1934.—Theories of the action of blocking-layer photoelectric cells are briefly reviewed. The author, from his results and those of Wood, concludes that it is necessary to postulate the existence of two blocking layers in such cells, each layer behaving so far as a.c. is concerned as a condenser shunted by a resistance. The discussion of their behaviour where d.c. is concerned necessitates the addition of impedances to the shunted condensers. J. S. G. T.

2227. Photoelectric Effects in Crystals of Argentite, Achantite and Cuprite. G. Athanasiu. *J. de Physique et le Radium*, 5. *pp.* 85–94, *Feb.*, 1934.—A study was made of the currents excited when single crystals of argentite, achantite and cuprite, mounted with suitable grid-form electrodes, are illuminated. In the case of argentite and of achantite a negative current in the direction crystal-illuminated electrode was produced; in the case of cuprite the current was in the opposite direction. The spectral response in the region $0\cdot4$–$1\cdot4\,\mu$ was investigated; the maximum for argentite was at $1\cdot15\,\mu$, for achantite at $1\cdot2\,\mu$ and for cuprite at $0\cdot64\,\mu$. The positions of the maxima were unaffected by the application of a polarising potential to the crystals, though the magnitude of the response was affected; in the case of argentite the sign of the effect was reversed when the potential applied was 0·08 volts. The position of the maximum in the case of argentite was affected slightly by polishing the surface of the crystal. The application of a polarising potential produces in addition temporary effects which are attributed to an electrolytic dissociation in the crystal. The positions of the maxima for argentite and achantite are the same as those found at low temperatures (−100° to −150° C.) for the photoconductive effect in similar crystals. The effects in argentite and cuprite are compared respectively with the photoelectric properties of thin films of silver sulphide on silver and of cupric oxide on copper. D. H. F.

2228. Compound Photo-Kathodes. R. Fleischer and P. Görlich. *Phys. Zeits.* 35. *pp.* 289–292, *April* 1, 1934.—An account is given of investigations of the properties of Cs-Cs_2O kathodes (oxide layer with embedded Cs atoms [see Abstract 5490 (1933)] after sensitisation by the method of depositing upon the surface a foreign and photoelectrically inactive metal. It is found that an increase of sensitivity is obtained as soon as the Cs-Cs_2O kathode becomes covered with a thin invisible layer of the foreign metal, and that a further slow increase occurs as the metal diffuses into the kathode layer. The final process in the treatment of the kathodes is an after-sensitisation by surface oxidation. The spectral sensitivity curves of these compound kathodes are investigated, using a double quartz monochromator. It is found that the deposition of the foreign metal causes an initial displacement of the long-wave maximum and the long-wave threshold towards the red; but that there is no further displacement accompanying the processes of diffusion and after-sensitisation. L. A. W.

2229. Comparison of Vacuum and Gasfilled Photoelectric Cells. G. A. Boutry and J. Orcel. *Comptes Rendus*, 198. *pp.* 808–810, *Feb.* 26, 1934.—The doubt expressed by L. Capdecomme [see Abstract 1566 (1934)] as to the strict proportionality between current and light flux in gasfilled cells is due to the difficulty of obtaining two strictly comparable fluxes, and applies equally to vacuum cells; an accuracy of 1 % being the practical limit; the claim to an accuracy of 0·25 % for vacuum cells is therefore doubtful. The maximum potential safely applicable diminishes as the light flux increases, and should never exceed 80 V. C. A. S.

2230. Proportionality of Photoelectric Cells. H. Schneller. *Zeits. f. Astrophysik*, 8. *pp.* 82–86, *Feb.*, 1934.—It is shown that, under the conditions under which photoelectric cells are used in the measurement of the brightness of stars, there is an almost strict proportionality between the intensity of illumination and the photoelectric current. In a note appended **H. Janssen** replies to criticisms by Schneller, of his paper [see Abstract 1358 (1934)]. J. E. K.

2231. Effect of X-Rays on Copper-Oxide Rectifier Photoelectric Cell. A. I. Danilenko and W. M. Tutschkewitsch. *Phys. Zeits. d. Sowjetunion*, 5. 2. *pp.* 359–366, 1934. *In German.*—It was established that when a copper-oxide rectifier photoelectric cell is irradiated by X-rays of wave-length 100–400 X. an e.m.f. approximately proportional to the intensity of the radiation is set up, provided that the spectral quality of the radiation remains constant. The response of the cell is found to be a maximum for $\lambda = 270$ X. approximately. It was found that the direction and magnitude of the current is the same whichever electrode is illuminated, if allowance is made for the thickness of the electrodes. The possibility of the use of this cell for measuring X-ray intensities is discussed. D. H. F.

2232. Rectifier Photo-Cells. R. Sewig. *A.T.M.* 3. T27–28, *Feb.*, 1934.—A general account of the construction and properties of rectifier photo-cells is given. Brief descriptions, with the names of the manufacturers, of special forms designed for various special purposes are included. D. H. F.

2233. Compensating Circuits for Rectifier Cells. N. R. Campbell and M. K. Freeth. *Journ. Sci. Instruments*, 11. *pp.* 125–126, *April*, 1934.

See also Abstracts 1978, 2013, 2081.

PIEZOELECTRICITY.

2234. Optical Demonstration of Harmonics and Oscillation Type of a Quartz Crystal and Applications. L. Bergmann. *Hochfrequenztechn. u. Elektroakustik*, 43. *pp.* 83–85, *March*, 1934.—It is shown that the optical method of Debye and Sears [see Abstract 4457 (1932)] for exhibiting h.f. sound oscillations in fluids can be used not only for the fundamental of an oscillating quartz crystal, but also for harmonics of high orders. This makes it possible to show the existence of harmonics in a valve transmitter by optical means and to utilise them for standardising purposes. The optical method also gives information as to whether the oscillation of the quartz has a single frequency or whether two or more frequencies exist at the same time. A. W.

THERMIONICS.

2235. Determination of the Primary Electron Current in Triodes by Energy Measurements. H. A. Schwarzenbach. *Helv. Phys. Acta*, 7. 1. *pp.* 108–148, 1934. *In German.*—A method is described for the separate determination of the primary and secondary electron currents in triodes. The method uses as distinguishing mark between the two kinds of electrons their energy, which can be ascertained from the heating of the electrodes produced by the electron bombardment. Then as both the p.d. and the energy are known the current can be calculated. The chief advantage lies in the fact that the secondary emission need not be artificially eliminated but rather the valve can be investigated under full working conditions. Two examples of the application with different courses of action are given to show the usefulness of the method. The discussion of the results shows the need for the assumption of considerable average initial energies of the secondary electrons, and, from disagreements in the determination of the lattice radiation coefficient, gives conceptions regarding the course of the electron paths in the interior of the valve. J. J. S.

2236. Anomalous Changes in Temperature due to Thermionic Emission in Valve Filaments. A. M. Ferasah. *Phys. Soc., Proc.* 46. *pp.* 338–343, *May* 1, 1934.—A triode should show, for a given filament current, a steady filament-temperature, lower when the anode is at a positive than when it is at a negative or zero potential. It has been found that in some valves the steady filament-temperature is lower when the anode is positive, as would be expected, but in other valves it is higher. It is shown that this anomalous increase in temperature is due to radiation from the anode and is larger for valves having a high anode dissipation and an anode which closely surrounds the filament. It is shown that when a correction for this effect has been applied the work function can be approximately calculated from measurements made on an ordinary valve. AUTHOR.

2237. Electron Emission from Oxide-Coated Kathodes. L. Piatti. *N. Cimento,* 11. *pp.* 77–98, *Feb.,* 1934.—Although the use of rare earth oxides for coating the kathodes of wireless receiving valves has been common for some considerable time the various theories governing the electron emission are still actively discussed. The kathodes now used generally consist of ribbons or tubes made of nickel or a nickel alloy and covered with a mixture consisting of approximately equal parts by weight of the oxides of barium and strontium. There are two principal methods of applying the oxide coating, one giving " combined " kathodes, in which there is a chemical action between the coating and the support, and the other giving " uncombined " kathodes, in which there is no such action. The former type are made with coatings more complex than simple oxides of barium and strontium, and are not in general industrial use. The two chief theories of the electron emission are: (1) That it is due to the oxides alone, and (2) that it is due to free barium. There are two schools of thought regarding the second theory, one suggesting emission from the free barium itself, and the other favouring the view that the emission is from the oxides but that free barium acts somewhat like a catalyst. These theories are fully discussed, and copious references are given to recent research. L. B. F.

2238. Distribution of Initial Velocities of Positive Ions from Tungsten. G. J. Mueller. *Phys. Rev.* 45. *pp.* 314–319, *March* 1, 1934.—The distribution of initial velocities of positive ions emitted from a hot tungsten filament *in vacuo* has been investigated by measuring the positive ion current from a short length (0·05 cm.) of filament to a coaxial cylindrical electrode against various retarding potentials. Measurements were made for eighteen different temperatures ranging from 1300° K. to 3000° K. The ion current consisted of not only tungsten, ions but also those of impurities, chiefly potassium. Within experimental error, it was found that the ions were emitted with velocities distributed in accordance with Maxwell's law. AUTHOR.

2239. Thermal Ionisation of Sodium Vapour at a Glowing Tungsten Surface. N. D. Morgulis. *Phys. Zeits. d. Sowjetunion,* **5. 2.** *pp.* **221–240, 1934.**—Results of experiments on the thermal ionisation of Na vapour at a W surface are found to agree with theory, especially at pressures of the order 10^{-5} to 10^{-3} mm. of Hg. At lower pressures, deviations occur due to secondary reactions which tend to mask the small primary effect. The influence of the outer field on the Na ions, produced by the thermal ionisation of Na, shows that the increase in ionisation, observed by an enlargement in the accelerating field of the ions, must be due to a kind of reversed Schottky-effect, that is, to an increase in exit-work of the electrons. H. M. B.

See also Abstracts **2225, 2241.**

THERMOELECTRICITY.

2240. Electrothermal Homogeneous Effect in Liquid and in Solid Metals. C. Benedicks and G. Siljeholm. *Arkiv f. Mat., Astron., och Fysik, Stockholm,* **24***A. No.* 1 [16 *pp.*] *and* **24***A. No.* 7 [36 *pp.*], **1933.** *In German.*—Further experiments are described confirming and extending the investigations already recorded on the electrothermic homogeneous effect [see Abstract **395** (1934)]. There exists in a uniform homogeneous conductor the tendency to a linear temperature distribution rising or falling in the direction of the current. What actual temperature distribution takes place depends on the respective surrounding conditions. For the case examined where two Cu blocks at constant temperature bounded a uniform conductor the agreement of theory with experiment was good considering the experimental difficulties. It was found possible to raise considerably the effectiveness of the electrothermic homogeneous effect by means of suitable arrangements. The signs found as well as the relative magnitude of the effect agree with expectations. The effect is proportional to the current strength. A quite unexpectedly large increase of the effect with the temperature was established. The production is considerably increased when a narrowed portion exists on the conductor. J. J. S.

2241. Electron Theory of Metals. A. Sommerfeld. *Naturwiss.* **22.** *pp.* **49–52,** *Jan.* **26, 1934.**—The present paper discusses the thermoelectric effect of Seebeck and the thermionic effect of Richardson from the standpoint of the electronic theory of metals and gives a brief but very comprehensive survey of work in these fields. H. H. Ho.

2242. Thermoelectric Metal-Crystal Analyser. M. F. Hasler. *Physics,* **5.** *pp.* **9–14,** *Jan.,* **1934.**—A device is described which allows the measurement of the thermoelectric e.m.f. at room-temperature for each increment of length of a metal test bar. A photographic arrangement permits a complete thermoelectric record of such a bar to be produced. [See also Abstract **1632** (1931).] AUTHOR.

See also Abstracts **1843, 2193, 2194.**